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VOLUME I

GOVERNMENT OPERATIONS

Post Remedial Action Report Lansdowne Radioactive Residence Complex Dismantlement/Removal Project

June 1990

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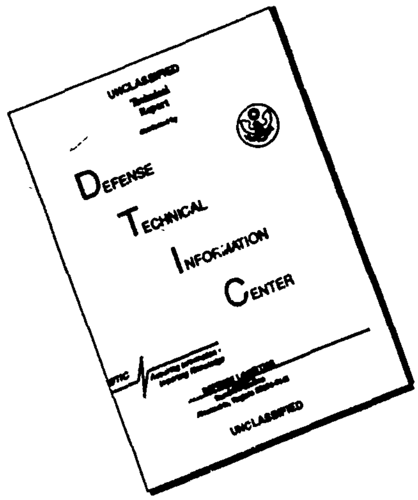

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VOLUME I

GOVERNMENT OPERATIONS

Post Remedial Action Report Lansdowne Radioactive
Residence Complex Dismantlement/Removal Project

Prepared By

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June 1990

90 11 23 1[illegible]

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
June 1990

3. REPORT TYPE AND DATES COVERED
FINAL (1 Aug 88 - 24 July 89)

4. TITLE AND SUBTITLE
Post Remedial Action Report, Lansdowne Radioactive Residence Complex, Dismantlement/Removal Project.
Volume I, Government Operations

5. FUNDING NUMBERS
C - DACW-45-88-C-0213
TA - BZLPA38221ØCDSI

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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P.O. Box 1715
Baltimore, MD 21203-1715

8. PERFORMING ORGANIZATION REPORT NUMBER
CENAB-CO/HTW/90-01/EPA(S)

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
United States Environmental Protection Agency
Region III
841 Chestnut Bldg., Philadelphia, PA 19107

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES This is Volume I of a 4-Volume set. Titles and Performing Organizations of other Volumes: Volume II "Contractor Operations," Chem-Nuclear Systems, Inc. Volume III, "Contractor's Radiological Closeout Report," CNSI. Volume IV, "Radiological Oversight and Certification Report," Argonne Natl. Laboratory

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release. Distribution Unlimited.

12b. DISTRIBUTION CODE

Pennsylvania.

13. ABSTRACT (Maximum 200 words)
The Lansdowne Radioactive Residence Complex at 105/107 E. Stratford Ave., Lansdowne, ~~Pa.~~ consisted of a 3-story duplex residence, two garages on the 105/107 property, two garages on immediately adjacent properties, and 250' of municipal sewer. The structures became contaminated during the period 1924-1944 by radium processing carried out in the basement of the 105 residence. Clean-up of the site necessitated the removal of 1430 tons (46,698 cu. ft.) of contaminated rubble generated by building and sewer dismantlement, and 4109 tons (83,226 cu. ft.) of radioactive soil that became contaminated because waste products from the radium processing activity were buried in the ground ~~all~~ around the site. Prior to remediation, radium levels in the soil ranged as high as 700 pCi/g; following remediation, radium levels had been reduced to no greater than 5 pCi/g above the local background of 1.5 pCi/g. Following removal of contamination, the site was backfilled to near original grade and restored as a grassed lot. A replacement sewer line was ~~also~~ constructed. The cost of the remediation effort roughly doubled over the original contract amount, from $4.9 million to $11.4 million, owing to the discovery of 4 times more contaminated soil than the original Government estimate. The project was brought to a successful conclusion without harmful radiation exposures to project personnel or the general public. (over)

14. SUBJECT TERMS
radiation hazard removal
Superfund
nuclear waste clean-up
radioactive site remediation
hazardous and toxic waste clean-up

15. NUMBER OF PAGES
289

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

(cont)

Keywords: Radioactive contamination/wastes; Decontamination/sites; Recovery/buildings/sewers; Radiation dosage/hazards; Radioactivity/debris/removal; Health physics; Pavements/excavation/replacement; Soils/contamination; Backfills/moisture content; Ionizing radiation; Hazardous materials; Nuclear radiation; Half life; Contaminants/removal; Radium processing; Residential section.
(MM)

PREFACE

This Post Remedial Action Report consists of an indivisible set of four volumes--indivisible in the sense that no volume can stand by itself to tell all that needs to be told about the Lansdowne effort.

Volume I, prepared by the U.S. Army Corps of Engineers, concentrates on the contractural, engineering, and Quality Assurance aspects of the job.

Volume II and Volume III are the product of the Prime Contractor, Chem-Nuclear Systems, Inc. In Volume II, Chem-Nuclear presents an overview of its operations and project management, while in Volume III, Chem-Nuclear covers the techincal topics of radiation monitoring and health physics.

Volume IV, by Argonne National Laboratory, provides the official U.S. Government certification that the goal of site decontamination was achieved.

There is no duplication of effort in any of the above works prepared by the principal participants of the Lansdowne cleanup. Each work presents an account of a different aspect of the job. Collectively, they provide the complete account of what transpired.

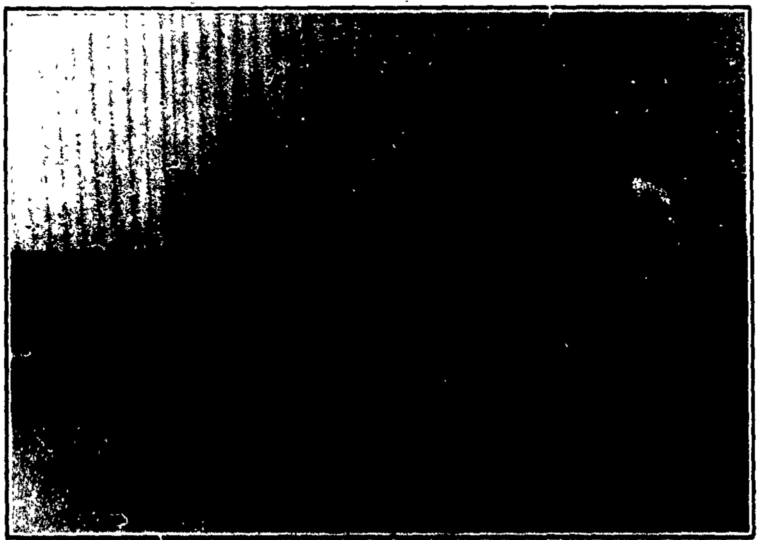
Acknowledgements

Prime Contractor for the Dismantlement and Removal of the Lansdowne Radioactive Residence Complex was Chem-Nuclear Systems, Inc., of Columbia, South Carolina. The Chem-Nuclear Project Manager, Mr. Raymond Huston, and his staff, ran the job for the U.S. Army Corps of Engineers. The subcontractor, Carlucci Construction Company, of Cheswick, Pennsylvania, provided most of the labor for site remediation and restoration. Radiation detection, identification and control were performed by the subcontractor, Hilbert & Associates. Certification that the site had been decontaminated was made by the Environmental Safety and Health Department, Argonne National Laboratory, under the direction of Dr. Robert Wynveen. The Government onsite representative for overseeing the work was Project Engineer, Walter Wickboldt, of the Baltimore District, Corps of Engineers. Upper level management of the project by the Government was carried out from the Baltimore District's Northeastern Resident Office, in Tobyhanna, Pennsylvania, under the direction of Mr. James P. Moore.

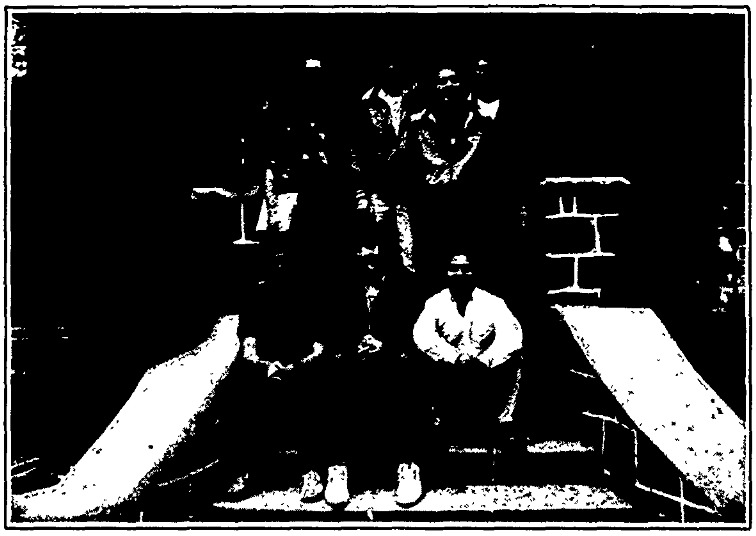
The project was funded by the U.S. Environmental Protection Agency and by the Pennsylvania Department of Environmental Resources as a Superfund remedial action. Mr. Victor J. Janosik, Remedial Project Manager, carried out project oversight for the EPA. Mr. Charles Formeck was the Project Officer for PADER.

The narrative, captioned photographs and design analyses presented in this Volume are the work of Project Engineer Wickboldt. Review and editing were accomplished by Mr. Moore, Mr. Edward G. Cox, Chief, Hazardous and Toxic Waste Section, Baltimore District, Mr. Denis DuBrueill, Area Engineer, Harrisburg Area Office, Baltimore District, Dr. Wynveen, Mr. Janosik, Mr. Formeck, and Mr. William Zobel, EPA Headquarters RD/RA Project Officer. Layout and publication of the report were accomplished by Mr. G. Wayne Parker and his staff, Information Support Services, Baltimore District, Corps of Engineers.

CNSI Onsite Project Staff. Left to right: Peter Trujillo, Site Health Physicist; Sherri Johnson, Office Manager; Raymond Huston, Project Manager.



Carlucci Construction Company. Front row, left to right: Robert Bowser, William Seitz, Richard Livengood, William Hazlett, Randy Fello. Back row, left to right: Robert Nameth, Michael Stanton, Buck Fox, Kenneth Goodwin, Marshall Utiss.



Hilbert & Assoc., RADCON Technicians. Seated, left to right: Larry Howie, William Jeske, Thomas Mojica. Standing, left to right: Mark Cafouras, Shawn Heffernan, William Rigby, Michael Zigo.

Argonne National Laboratories, Health Physics Department. Front row, left to right: Alfred Lissy, Charlotte Sholeen, Leland Sprouse, Gerald Haruch, Jesse Thereon. Middle row: William Munyon, Joseph Ello, Marian Williams, Daniel McNamee, MacLewis Robinet, Robert Wynveen. Back row: Carl Hunkler, George Mosho, Clifford Gains, David Reilly, George Ketchmark.

U.S. Government Onsite Representative. Walter Wickboldt, Civil Engineer, Baltimore District, Corps of Engineers.

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GLOSSARY

GLOSSARY

Ac-227 — Actinium-227. Radioactive progeny of the Uranium-235 decay series having 89 protons and 138 neutrons in the nucleus of the atom (89 + 138 = 227). Half life: 21.8 years. Major radiation energy: beta (0.043 MeV).

activity — The number of nuclear transformations occurring in a given quantity of material per unit of time. The unit of measure is the Curie (Ci).

airborne contamination — The term applied to unwanted radioactive particulates suspended in air.

ALARA — An acronym for "as low as reasonably achievable"; refers to an operating philosophy in which occupational exposures to radiation are reduced as far below specified limits as is reasonably achievable, given the social and economic constraints.

alpha radiation — A charged particle that is emitted from the nucleus of an atom that has a mass and charge equal in magnitude to those of a helium nucleus, i.e., two protons and two neutrons. Alpha radiation has the highest ionizing potential--about 300 times as great in air as that of beta radiation. The range that alpha radiation will travel in air is about 3 inches. It will not penetrate beyond the first layer of human skin, so a dose of alpha radiation must be acquired internally to produce a radiation hazard.

ambient radiation — The radiation level (alpha, beta and/or gamma) that is characteristic of the environment of a particular local. Ambient radiation may or may not constitute a radiation hazard.

ANL — An acronym for "Argonne National Laboratory," Argonne, Illinois. An affiliate of the U.S. Department of Energy and the University of Chicago. The Environmental Safety and Health Department of ANL provided technical support to the Corps of Engineers and certified the Lansdowne site to be free of radioactive

contamination at the conclusion of clean-up.

<u>Argonne</u> — Argonne National Laboratory (See ANL)

<u>ASTM</u> — Abbreviation for "American Society for Testing and Materials." Restoration of the Lansdowne Site following the removal of contamination was carried out in part according to ASTM standards.

<u>atom</u> — The smallest unit of an element that is capable of entering into a chemical reaction. Stable atoms have a nucleus of neutrons and positively charged protons. Negatively charged electrons, equal in number to the protons, orbit the nucleus.

<u>atomic number</u> — The number of protons in the nucleus of an atom. The atomic number is unique to each of the 105 elements occurring in the universe (natural and man-made).

<u>atomic weight</u> — The sum of the number of neutrons and protons in the nucleus of the atom of an element. e.g., Ra-226: The element of Radium-226 has 88 protons and 138 neutrons in the nucleus of its atom. 88 + 138 = 226.

<u>B-25 Box</u> — An air-tight, 10-gauge steel box of welded construction, having the dimensions 4' x 4' x 6'. Used to containerize radioactive waste shipped from the Lansdowne site to the Envirocare disposal facility in Utah. The box could hold over 5.5 tons of material.

<u>background</u> — Radiation in man's natural environment due to cosmic rays and radiation from natural radioactive elements.

<u>beta radiation</u> — A charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to those of an electron. Beta radiation results from the transformation of a neutron into a proton and an electron. Beta particles may have a range in air of up to 20 feet; may penetrate 1/16-inch of aluminum and several inches of human skin.

Bi-214

Bismuth-214. A radioactive progeny of Ra-226 and the U-238 decay series, having 83 protons and 131 neutrons in the nucleus of the atom. Half life: 19.7 minutes. Major radiation intensity: gamma (0.609 MeV); beta (1.54-3.27 MeV). The concentration of Bi-214 in verification soil samples, as determined by gamma spectroscopy, was used to determine the concentration of the parent nuclide, Ra-226.

bidder

A respondent to the solicitation of the U.S. Army Corps of Engineers to remediate the Lansdowne site for a fixed fee.

bioassay

Measurement of the amount or concentration of radioactivity in material excreted or removed from the body for purposes of estimating the quantity of radioactive material in the body. Generally, a series of urine or fecal samples are analyzed at various time post-intake, to estimate the magnitude of the intake of radioactive material.

borrow

A term applied to clean soil that was brought in from an offsite location and used to backfill the Lansdowne site to approximately original grade following excavation and removal of contaminated soil.

CAM

An acronym for "Continuous Air Monitoring" station. CAMS continually monitored the air around the jobsite for airborne radioactive particulates. Detected both alpha and beta/gamma emitters. Designed to alarm if the concentration of radionuclides in the air approached the maximum permissible concentration (MPC) established in the Code of Federal Regualtions. USNRC 10 CFR Part 20.

cfm

Cubic feet per minute. The unit of measurement for the volume of air drawn through a HEPA filter or a grab-air sampler.

Chem-Nuclear

Chem-Nuclear Systems, Inc., Columbia, S.C. The successful bidder who was awarded the contract to remediate the Lansdowne site.

CNSI

Chem-Nuclear Systems, Inc.

consolidation	The term applied to the slow decrease in the volume of a soil as a result of the squeezing out of the pore water when the soil is subjected to the load of an overlying structure. Consolidation of supporting soil may result in long-term differential settlement (e.g., Leaning Tower of Pisa).
contamination	The presence of radioactive material in any place where it is not desired, and particularly in any place where its concentration exceeds maximum permissible concentrations established in the guidelines of regulatory agencies.
contamination (fixed)	Radioactivity (i.e., radionuclides) that cannot be removed from a surface by wiping.
contamination (loose)	Radiation emitters that can be removed from a surface by wiping or smearing.
Contractor	Chem-Nuclear Systems, Inc.
Cost Evaluation Team	The team of evaluators that examined the pricing data in the Proposals submitted by firms to remediate the Lansdowne site.
cpm	Counts per minute. The number of ionizing events detected over a period of one minute with a radiation detector.
cross-contamination	Contamination not from an original source, but acquired from another contaminated object. With respect to the Lansdowne project, it was most frequently used to refer to contamination that got tracked out of the radiation controlled zone to contaminate previously clean materials.
Curie	The standard measure of the rate of radioactive decay, 3.7 x 10(10) disintegrations per second. A pico-Curie is one trillionth of a Curie--1 x 10(-12). A micro-Curie is one millionth of a Curie--1 x 10(-6).

daughter	The product of radioactive decay, resulting in a new element with a different number of neutrons and/or protons in the nucleus of the atom.
decontamination	The reduction or removal of radioactive contamination from any given surface so that it meets or exceeds the release criteria specified for unrestricted use in NRC Regulatory Guideline 1.86.
detector	The component of a radiac instrument for converting ionizing radiation to a form more suitable for observation. Most nuclear radiation-detection devices are based either on the ionization produced in gases by incident radiation (e.g., ionization chambers and Geiger-Mueller tubes) or by crystals that give off flashes of light when bombarded by radiation which in turn produces free electrons in a photomultiplier tube (scintillation detectors). The flow of the ions or electrons in the detector tubes constitutes an electric current which is readily measured by a meter--the other principal component of the radiac. The magnitude of the electric current is directly proportional to the intensity of the incident radiation; hence electrical-meter readings can be obtained which are a measure of the dose rate of the incident radiation.
disintegration	The transformation of the nucleus of an atom into a different element, characterized by the emission of energy and/or mass from the nucleus. When numbers of nuclei are involved, the process is characterized by a definite half life.
DOE	U.S. Department of Energy.
dose	A general term denoting the quantity of radiation or energy absorbed. For special purposes, the term must be qualified. If unqualified, it refers to the absorbed dose.
dose, absorbed	The amount of energy imparted to matter in a volume element by ionizing radiation, divided by the mass of irradiated material in that element. The common unit of absorbed dose is the rad, which is equal to 100 ergs of absorbed energy per gram of material.

dose, equivalent	The product of the absorbed dose, the quality factor (i.e., similar types of radiation emitted by different radionuclids have varying degrees of penetrating power in biological tissue), and any other factors necessary to evaluate the effects of irradiation received by exposed persons. This unit of measure takes into account the particular characteristics of the exposure. The common unit of dose equivalent is the rem. Absorbed doses of different types of radiation are not addative, but dose equivalents are, because they express on a common scale the amount of damage incurred.
dosimeter	An instrument to detect and measure accumulated gamma radiation exposure. The thermoluminescent dosimeters (TLD) used on the Lansdowne project utilized a phosphor sensitive to ionizing radiation. The phosphor stored the energy of the ionization within itself and released it as low-energy photons (light) when heated. The total amount of light released is proportional to the total energy absorbed by the crystal which can be related to the actual dose equivalent received by the wearer.
dpm	Disintegrations per minute. A measure of the activity (i.e., the rate of radioactive decay) of a radionuclide. dpm is not the same as cpm. cpm refers to the number of disintegrations that were actually detected by a radiation detector, which is always some fraction of dpm owing to the inefficiency of the counting instrument.
dry density	Dry density is the weight per unit volume of the solid constituents of a soil, determined after all moisture has been removed by oven drying. Dry density is the common basis for judging the degree of compaction of earth fills.
efficiency	The probability that a count will take place when the radiation to be detected enters the radiation counter tube. Radiation counters have a resolving or "dead time" following an ionizing event during which the tube is insensative to additional ionizing radiation. Efficiencies of the radiation detectors used on the Lansdowne project ranged from around 15% for some of the portable gamma survey instruments to up to 50% for laboratory detectors.

electron volt	A unit of energy equivalent to the kinetic energy gained by an electron in passing through a potential difference of 1 volt. Larger units of the electron volt are frequently used: KeV for thousand or kilo-electron volts; MeV for million or mega-electron volts. 1 eV = 1.6 x 10(-12) erg.
EPA	The U.S. Environmental Protection Agency, more specifically EPA Region III, operating out of Philadelphia, Pa.
exposure	(1) For x or gamma radiation, the sum of the electrical charges of all the ions of one sign produced in air when all electrons liberated by photons in a small volume of air (at STP) are completely stopped in air, divided by the mass of air in the divided by the mass of the air in the volume. The unit of exposure is the roentgen (R).
exposure rate	(1) The exposure divided by the time over which it was accumulated. (2) The increment of exposure during a suitably small interval of time, divided by that interval of time. The usual units of exposure rate are micro-R/hr., or mill-R/hr.
flux	The quantity of ionizing radiation flowing per unit of time per unit area (e.g., photons/sq. cm./sec.
gamma radiation	Electromagnetic radiation that accompanies rearrangement of the particles in the nucleus of an atom. There is no change in atomic number or weight. The ionizing potential of gamma radiation depends on the intensity of the flux, as a gamma photon must strike an orbital electron in order to knock it out of orbit and ionize the atom. Since the atom is mostly empty space, the probability that a gamma photon will strike an electron in its passage through matter is not high. The range of a flux of gamma radiation is therefore said to be "infinite." Some of the photons are always going to pass through.

geometry

The particular counting arrangement between a radioactive source or sample being analyzed and a detector. Put another way, geometry refers to the fraction of the total solid angle about the source of radiation that is subtended by the detector. Sample geometry affects the overall counting efficiency.

Government

A collective term applied to all U.S. Government agencies directly involved with the Lansdowne project--the U.S. Army Corps of Engineers, the EPA and ANL. Wherever in the report "Government" is used in the context of contract administration, project control, and acceptance of the work, it refers to the Corps of Engineers. In radiological oversight matters, "Government" refers to ANL. In matters of Superfund program management, project authorization and funding, it refers to the EPA.

half-life

The time required for a radioactive substance to lose 50% of its activity by decay. Each radionuclide has a unique half-life. For Radium-226 (Ra-226), the principal contaminant at the Lansdowne site, the half-life was 1602 years.

hazardous waste

Chemicals discovered on the Lansdowne site of either unknown chemical composition, or else of known chemical composition for which Threshold Limit Values had been established by the American Conference of Governmental Industrial Hygienists, necessitating RCRA disposal.

Health Physics

The science and profession devoted to protecting man and the environment against unnecessary exposure to ionizing radiation. The name "health physics" derives from the fact that physical processes rather than chemical processes are at work in radioactive decay, and radioactive decay can have a detrimental effect on biological tissue.

HEPA filter

"High Efficiency Particulate Air" filter. Used to purify breathing air in personnel respirators and to remove airborne radioactive particulates from the workplace when used in association with high volume vacuums.

IH	Industrial Hygienist. One who professionally practices the vocation of identifying hazards to which workers are exposed in the industrial environment and implements measures to either eliminate the hazards or render the associated risks tolerable. A certified IH, employed by the Contractor, served as the Site Health and Safety Officer on the Lansdowne project.
intake	The entry of radioactivity into the body via a number of different pathways: inhalation, ingestion, skin absorption.
internal radiation exposure	Radiation exposure received from radioactive material internally deposited in the body.
in-vivo counting	Measurements of internal radioactivity made at the surface (outside) of the body and based on the fact that radioisotopes emit radiation that can traverse tissues and be measured outside the organism. In-vivo counting is done to estimate the quantity of radioactive material deposited in the body. It is synonomous with whole-body counting.
ion	An atomic particle or atom bearing an electric charge, either negative or positive.
ionization	The removal of an orbital electron from a neutral atom as a result of incident nuclear radiation. The resulting positively charged atom and the negatively charged electron that was removed are referred to as an ion pair. Positively charged alpha particles (+2) ionize by attracting negatively charged electrons (-1) orbiting the atoms of the medium through which they are passing, pulling the electrons out of orbit. Negatively charged beta particles ionize by repelling negatively charged ions out of orbit. Gamma radiation ionizes by striking and knocking orbital electrons out of their position in the atom. The freed electron behaves as a beta particle and can cause further ionizations by repelling electrons out of the orbits of other atoms. The original ionizations produced by gamma radiation are called primary ionizations; the ionizations caused by the freed electrons are called secondary ionizations.

<u>ionizing effects</u>	Result from the propensity of ions to enter into chemical reactions. Only electrons take part in chemical reactions; thus anything that effects the orbital electrons of atoms may effect their chemical reactions. Some of the chemical reactions which might take place in biological tissue: (1) Complex protein chains may be broken; the smaller chains resulting cannot perform the same physiological function as the longer chain; as a result, the functioning of the living cell might be impaired. (2) Water molecules in the body may be converted to molecules of hydrogen peroxide (and other oxydizing agents) which may produce other chemical reactions abnormal to the cells functioning. If sufficient cells in the organism become sick or die, the organism will become sick or die. The severity of the illness depends on the amount of radiation absorbed.
<u>isotope (radioisotope)</u>	Nuclides that have the same number of protons in their nuclei, hence the same atomic number, but differ in the number of neutrons and therefore in atomic weight. Example: Radium has 88 protons in the nucleus. There are 13 isotopes of radium having atomic weights ranging from 213 to 230 because of varying numbers of neutrons in the nucleus. Ra-226, the principal contaminant at Lansdowne, had a nucleus containing 138 neutrons. 88 + 138 = 226. Radioactive isotopes have a disproportionate number of neutrons to protons.
<u>K-40</u>	A radioactive isotope of potassium having 19 protons and 21 neutrons in the nucleus. Half life: 1.26 billion years. Major radiation intensities: beta, 89% (1.3 MeV); gamma, 11% (1.46 MeV). Naturally occurring.
<u>KeV</u>	Kilo-electron volt. Equal to 1000 electron volts, or 1.6 x 10(-9) erg.
<u>MDA</u>	Minimum Detectable Activity. Refers to the minimum detectable radioactivity above background and was one of the criteria used to classify rubble as contaminated during remediation of the Lansdowne site. It was also frequently referred to as the 2-Sigma contamination criteria, based on standard Gaussian statistics for a 95% confidence level (i.e., two standard deviations in the background counts of gamma radiation). There was a 95% degree of confidence that a

detected level of radiation was indicative of the presence of radioactivity above background levels.

<u>MeV</u>	Mega-electron volt. Equal to 1,000,000 electron volts, or 1.6 x 10(-6) erg.
<u>micro</u>	A prefix denoting one millionth (1/1,000,000).
<u>micro-Curie</u>	1/1,000,000 of a Curie, or 37,000 disintegrations per second.
<u>micro-R</u>	1/1,000,000 of a Roentgen. The quantity of gamma or x-radiation which produces 2083 ion pairs per cubic centimeter of dry air.
<u>micro-R/h</u>	Exposure rate in micro-Roentgens per hour.
<u>milli</u>	A prefix denoting one thousandth (1/1,000).
<u>millirem</u>	1/1,0000 of a rem. The absorbed dose of radiation (alpha, beta and/or gamma) necessary to produce approximately 2.083 x 10(6) ion pairs in man per gram of body tissue.
<u>MPC</u>	Maximum Permissible Concentration. Refers to the maximum permissible concentration for radionuclides suspended in air and/or water, as established by the Code of Federal Regulations (10 CFR 20). For Ra-226 in air, the MPC is 3 x 10(-11) micro-Curies per milliliter; in water, the MPC is 4 x 10(-7) micro-Curies per milliliter.
<u>mrem</u>	See millirem.
<u>nano</u>	A prefix denoting one billionth (1/1,000,000,000).
<u>neutron</u>	One of three sub-atomic particles, which is part of all nuclei heavier than hydrogen. Neutrons have no charge, in contrast to protons (+) and electrons (-).

NORM	An acronym for "naturally occurring radioactive material," such as radium and radon, that are found in nature but are not classified as source material.
NRC	The United States Nuclear Regulatory Commission.
nucleus	That part of an atom in which the total positive electric charge and most of the mass are concentrated.
nuclide	A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons (Z), number of neutrons (N), and energy content; or, alternatively, by the atomic number (Z) and atomic weight (A=N+Z). To be regarded as a distinct nuclide, the atom must be capable of existing for a measureable period of time.
Optimum Moisture Content	The moisture content expressed as a percentage of dry soil weight at which a soil can be compacted to maximum dry density.
OSHA	Occupational Safety and Health Administration
Pa-231	Protactinium. A progeny of the U-235 decay series having 91 protons and 140 neutrons in the nucleus. Half life: 32,500 years. Major radiation intensity: alpha (5 MeV).
PADER	Pennsylvania Department of Environmental Resources.
parent	A radionuclide which, upon disintegration, yields a specified nuclide, either directly or as a later member of a radioactive series.
PennDOT	Pennsylvania Department of Transportation.
Personnel Monitoring	Utilization of dosimetry and bioassay to measure the radiation dose acquired by an individual working in a radiation area.

PHA — Abbreviation for "Phase Hazard Analysis"--a document detailing how a particular work activity was to be executed, identifying the hazards associated with the work and the safety measures that would be implimented to either eliminate the hazards or make the risks acceptable. The PHA was prepared by the Contractor and submitted to the Government for approval prior to beginning each new phase of work. All workers also read and signed the PHA prior to beginning the phase of work.

pico — A prefix denoting one trillionth (1/1,000,000,000,000).

pCi/g — pico-Curies per gram. An activity concentration of one trillionth of a Curie per gram of material or 2.22 disintegrations per minute per gram of material. A radium concentration of 5 pCi/g above natural background was the release criteria established for contaminated soil remediation at Lansdowne.

Proposal — An offer submitted by a bidder in response to a Request for Proposal (RFP), detailing how he would go about remediating the Lansdowne site if he were awarded the job, and how much he would charge for his services.

protective clothing — The clothing worn by radiation workers to prevent radioactive contamination of the body or personal clothing. At Lansdowne, protective clothing consisted of cotton or tyvek coveralls, leather-palm gloves with inner cotton-glove liners and disposable plastic boot covers.

protective equipment — Safety devices used to prevent personal injury. At Lansdowne, protective equipment consisted of hard hats, steel-toed boot, safety goggles, air-hat or full-face respirators, ear plugs, and on occasion, a life line/harness.

proton — A sub-atomic nuclear particle with a positive electric charge equal numerically to the charge of the electron.

PTL — Abbreviation for "Pitsburgh Testing Laboratories"--the geotechnical firm that tested backfill and new asphalt pavement to determine if compaction specifications had been met.

Q/A — Quality Assurance. Actions by the Government Onsite Representative to ensure that the Contractor's Q/C System and his work (including sampling and testing)) were in accordance with the contract documents.

Q/C — Quality Control. The Contractor's management system for producing construction/remediation complying with the terms of the contract.

Ra-226 — Radium 226. Radioactive element of the U-238 decay series having 88 protons and 138 neutrons in the atomic nucleus. Half life: 1602 years. Major radiation intensities: alpha (4.78 MeV), gamma (0.186 MeV). Ra-226 was the principal contaminant at the Lansdowne site.

rad — The unit of absorbed dose. 1 rad equals the absorption of 100 ergs of energy per gram of material. The rad considers exposure from all types of nuclear radiation, where the Roentgen considers only x and gamma radiation. Absorption of radiation depends on the absorption factor of the medium which is less than 1 for all biological tissue, with the result that the absorbed dose in rads will always be numerically less than the exposed dose in Roentgens. Absorption factors for particular tissues have been published, but for general field use, rad and Roentgen are considered equivalent for gamma radiation. This conservative assumption results in estimating a greater absorbed dose than what the actual absorbed dose really is and conforms to the spirit of the ALARA concept.

radiac — An acronym for "radiation detection, identification and computation." It is applied to radiation instruments which perform any or all of these tasks.

RADCON — An acronym for "Radiation Control Technicians," employed by the Contractor to direct the excavation of contaminated soil, decontaminate personnel and equipment, and

perform other miscellaneous tasks dealing with the handling of radioactive materials.

<u>radiation (ionizing)</u>

1. Any electromagnetic wave (e.g., gamma)

2. Any moving nuclear particle emitted by a a radioactive substance, charged (e.g., alpha and beta), or uncharged (e.g., neutrons).

<u>radiation survey</u>

An evaluation of the radiation levels that can be expected to be encountered while performing a phase of work, with the aim of determining the proper methods for accomplishing the task and the necessary protective clothing and equipment that will be required. Methods of the evaluation may include gamma survey measurements to determine the external exposure hazard. Air sampling and swipe sampling of surface areas to determine if their is loose alpha contamination that could pose an internal radiation hazard.

<u>radionuclide</u>

A nuclide that emits radiation. (See nuclide).

<u>RBE</u>

Relative Biological Effectiveness. The RBE is a multiplier which converts dose units in rads to dose units in rem. RBE = rem/rad. A rad of one kind of radiation does not necessarily produce the same biological effect as a rad of another kind of radiation. Values of the RBE for different types of nuclear radiation are:

x or gamma rays	1
beta particles	1
fast neutrons	10
slow neutrons	5
alpha particles	10-20

<u>release criteria</u>

The level of radioactivity to which radioactively contaminated equipment and materials must be decontaminated in order to permit them to be released for unrestricted use.

<u>rem</u>

Roentgen Equivalent Man. One rem is an absorbed dose that will produce the same biological effect in man as the <u>absorbed</u> dose from <u>exposure</u> to one Roentgen of x or gamma radiation. The rem is the dose unit of

absorption that considers the relative biological effectiveness (RBE) of different radiation types and places them all on an equal level. Example: 1 rad of gamma plus 1 rad of alpha equals an absorbed dose of 2 rads. But alpha radiation has an RBE of 10 to 20 times that of gamma radiation, so 1 rad of alpha plus 1 rad of gamma equals 11-21 rem. In man, one rem produces around 2.083 x 10(9) ion pairs per gram of tissue. 500 mrem/year is the current dose limit established for the general public.

respirator — A device equiped with HEPA filters to prevent the inhalation of airborne radioactive particulates by the wearer. Respirators come in a variety of models (half-face, full-face, negative air-pressure, powered air-purifying, etc.). Each model has an assigned factor of safety. Respirators used at Lansdowne had factors of safety in the range of 50 to 100, which was adequate because the concentration of airborne radioactive particulates inside the house during dismantlement never exceeded around 5 times the MPC.

ROD — An acronym for Superfund "Record of Decision" --a document issued by the EPA which describes the hazards and the remedy to mitigate and minimize damage to public health, welfare, and the environment, resulting from the existence of a hazardous toxic waste (HTW) site, and authorizes the expenditure of Superfund money to implement the site remediation.

Roentgen — The unit of exposure to (but not necessarily absorption of) gamma or x-radiation. One Roentgen will produce, in one gram of air (i.e., cubic centimeter) or one gram of soft tissue, an amount of ionization equal to one electrostatic charge (i.e., an electric charge that will repel and accelerate a particle of similar charge at one centimeter distance at one cm/sec/sec). One Roentgen produces approximately 2.083 x 10(9) ion pairs per cubic centimeter of air or gram of soft tissue. This requires 87 (approximately) ergs of energy per gram of air or 93 (approximately) ergs of energy per gram of soft tissue. For dosimetry purposes, the Roentgen is considered equivalent to absorbed dose in rem for gamma radiation. Since the absorbed dose is usually something less than the exposed dose, this conservative

assumption prevents underestimation of the true gamma radiation dose a worker received.

<u>RFP</u>

Abbreviation for "Request for Proposal"--a solicitation issued by the U.S. Army Corps of Engineers to firms specializing in the remediation of radioactive sites, to submit a <u>Proposal</u> for remedial and restoration actions at the Lansdowne site, with special attention given to the method of minimizing (by both weight and volume) radioactive waste disposal and the mitigation of radioactive aerosols, and to offer a price for doing the work.

<u>scalar/ratemeter</u>

A radiac instrument that is capable of operating in two modes. In the <u>ratemeter</u> mode, the instrument takes the number of counts being detected at any instant and converts them to equivalent counts per minute, which are displayed on a meter. In the <u>scalar</u> mode, the counting time is pre-selected (1 second to 4 hours) and the readout of the number of counts is integrated over the specified counting period. Sophisticated scalars can detect the different energies of the emissions.

<u>series (radioactive)</u>

A sucession of nuclides, each of which transforms by radioactive disintegration into the next, until a stable nuclide results. The first member is called the "parent," the intermediate members are called "daughters," and the final stable member is called the "end product."

<u>shield</u>

A body of material used to prevent or reduce the passage of particles of radiation. Gamma scintillation detectors used on the Lansdowne project were frequently shielded on the sides so that the only radiation reaching the detector had to come from a source directly below the detector (or from the exact location which was the subject of investigation).

<u>spectroscopy</u>

Measurement of the energies of different types of radiation to <u>identify</u> and <u>quantify</u> the type or types of radionuclides responsible for the emissions.

<u>subcontractor</u>

A specialty firm hired by CNSI to undertake a specific phase of work associated with the Lansdowne project.

Technical Evaluation Team	The team which evaluated and rated the proposals submitted by bidders on the Lansdowne project, based on technical merit.
Th-230	Thorium-230. A radionuclide of the U-238 decay series having 90 protons and 140 neutrons in the nucleus. Half life: 80,000 years. Major radiation intensity: alpha (4.68 MeV). Th-230 is a daughter nuclide of Uranium-234 and a parent nuclide of Radium-226. It was found as a contaminant in minor amounts on the Lansdowne site.
Two-Sigma Criterion	See MDA.
Unit Price	An item of work singled out by the Government for which the Contractor was required to give a fixed price. The cost of disposal by the ton for contaminated soil and contaminated rubble were unit-price contract pay items. In contrast to a unit-price pay item, a lump-sum pay item may contain many work activities necessary to accomplish the job, for which the Contractor gives only one all encompasing price.
Uranium-238 Decay Series	

Element	Symbol	Half Life	Decay Process
Uranium	${}_{92}U^{238}$	4.5×10^{9} yr	${}_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_{2}\alpha^{4} + Q$
Thorium	${}_{90}Th^{234}$	24.1 days	${}_{90}Th^{234} \rightarrow {}_{91}Pa^{234} + {}_{-1}e^{0} + {}_{0}\gamma^{0} + Q$
Protactinium	${}_{91}Pa^{234}$	1.14 min	${}_{91}Pa^{234} \rightarrow {}_{92}U^{234} + {}_{-1}e^{0} + {}_{0}\gamma^{0} + Q$
Uranium	${}_{92}U^{234}$	2.33×10^{5} yr	${}_{92}U^{234} \rightarrow {}_{90}Th^{230} + {}_{2}\alpha^{4} + Q$
Thorium	${}_{90}Th^{230}$	8×10^{4} yr	${}_{90}Th^{230} \rightarrow {}_{88}Ra^{226} + {}_{2}\alpha^{4} + {}_{0}\gamma^{0} + Q$
Radium	${}_{88}Ra^{226}$	1612 yr	${}_{88}Ra^{226} \rightarrow {}_{86}Rn^{222} + {}_{2}\alpha^{4} + {}_{0}\gamma^{0} + Q$
Radon	${}_{86}Rn^{222}$	3.825 days	${}_{86}Rn^{222} \rightarrow {}_{84}Po^{218} + {}_{2}\alpha^{4} + Q$
Polonium	${}_{84}Po^{218}$	3.05 min	${}_{84}Po^{218} \rightarrow {}_{82}Pb^{214} + {}_{2}\alpha^{4} + Q$
Lead	${}_{82}Pb^{214}$	26.8 min	${}_{82}Pb^{214} \rightarrow {}_{83}Bi^{214} + {}_{-1}e^{0} + {}_{0}\gamma^{0} + Q$
Bismuth	${}_{83}Bi^{214}$	19.7 min	${}_{83}Bi^{214} \rightarrow {}_{84}Po^{214} + {}_{-1}e^{0} + {}_{0}\gamma^{0} + Q$
Polonium	${}_{84}Po^{214}$	1.5×10^{-4} sec	${}_{84}Po^{214} \rightarrow {}_{82}Pb^{210} + {}_{2}\alpha^{4} + Q$
Lead	${}_{82}Pb^{210}$	22.2 yr	${}_{82}Pb^{210} \rightarrow {}_{83}Bi^{210} + {}_{-1}e^{0} + {}_{0}\gamma^{0} + Q$
Bismuth	${}_{83}Bi^{210}$	4.97 days	${}_{83}Bi^{210} \rightarrow {}_{84}Po^{210} + {}_{-1}e^{0} + Q$
Polonium	${}_{84}Po^{210}$	138 days	${}_{84}Po^{210} \rightarrow {}_{82}Pb^{206} + {}_{2}\alpha^{4} + Q$
Lead	${}_{82}Pb^{206}$	Stable	

verification samples	Soil samples which were collected, split between the Contrctor and ANL, and analyzed by gamma spectroscopy to verify conclusions based on the use of survey instruments that all contaminated soil had been removed, and that the remaining soil left on the site had an activity of not more than 5 pCi/g above the natural background.
whole-body count	See in-vivo monitoring.
Working Level (WL)	Any combination of short-lived radon daughters in one liter of air that will result in the ultimate emission of 1.35 MeV of alpha energy (equivalent to a concentration of 100 pCi/liter of air).

CHAPTER 1

INTRODUCTION

1.0

INTRODUCTION

1.1 Purpose.

The purpose of this report is:

(1) to satisfy Corps of Engineers reporting requirements pertaining to the preparation of Post Remedial Action Reports on Superfund projects. [1]

(2) to provide information to the EPA which will assist in their deletion of the Lansdowne site from the National Priorities List.

(3) to provide a chronological narration of the work performed and the problems overcome.

(4) to document the supervision and administration role performed by the U.S. Army Corps of Engineers.

(5) to preface and complement the close-out reports of Chem-Nuclear Systems, Inc. and Argonne National Laboratory, so that there will be a balanced set of perspectives from the three main participants involved with the day-to-day remediation and restoration of the site.

(6) to document the lessons learned for any future radiation clean-ups undertaken by the Corps of Engineers.

(7) to provide a technical reference for engineering data, apart from the radiological data presented in the close-out reports of Chem-Nuclear and Argonne.

1.2 Scope.

This report begins with a brief presentation of site history, explaining how it became contaminated, and why the EPA's selected remedy was dismantlement and removal. It then describes the role of the Corps of Engineers through the process of finding the best Contractor to do the work, the approval of his plans for doing the work, and how the work of remediation and restoration was safely and satisfactorily accomplished. It concludes with a discussion of how some things might have been done differently with the benefit of hindsight.

1.3 Site Location.

The Lansdowne Radioactive Residence Complex consisted of a duplex residence and two garages located at 105/107 East Stratford Avenue, in Lansdowne, Delaware County, Pennsylvania. The site is located on a side street in a residential area, approximately two miles from Philadelphia.

Maps showing the location of Lansdowne with respect to the Philadelphia area, the location of the Stratford Avenue residence with respect to the Borough of Lansdowne, and a site map of the Stratford Avenue property, are provided in Figures 1:1, 1:2 and 1:3 respectively. [2]

1.4 Project Objectives.

Objectives of the project were to dismantle the house and garages on the Stratford Avenue property and dispose of the radioactive portions at an appropriate disposal site. Uncontaminated rubble was to be disposed of in a clean landfill. Soil on the site containing Radium-226, in excess of 5 picoCuries/gram above the local natural background was also to be removed, as was similarly contaminated soil and/or structures on adjacent properties that may have been contaminated owing to migration of the radioactivity off the 105/107 Stratford Avenue property. Finally, the Stratford Avenue property was to be backfilled to original grade and left as an empty grassed lot. Any contaminated soil, trees or structures that would have to be removed on adjacent properties were to be replaced in kind.

1.5 Participating Government Agencies.

Remediation and restoration were performed under a service contract, which was negotiated and awarded by the Omaha District, Corps of Engineers, and administered by the Baltimore District, Corps of Engineers, for the United States Environmental Protection Agency, Region III. Argonne National Laboratory provided technical support and radiological quality assurance monitoring for the Corps of Engineers during the remediation phase of the work.

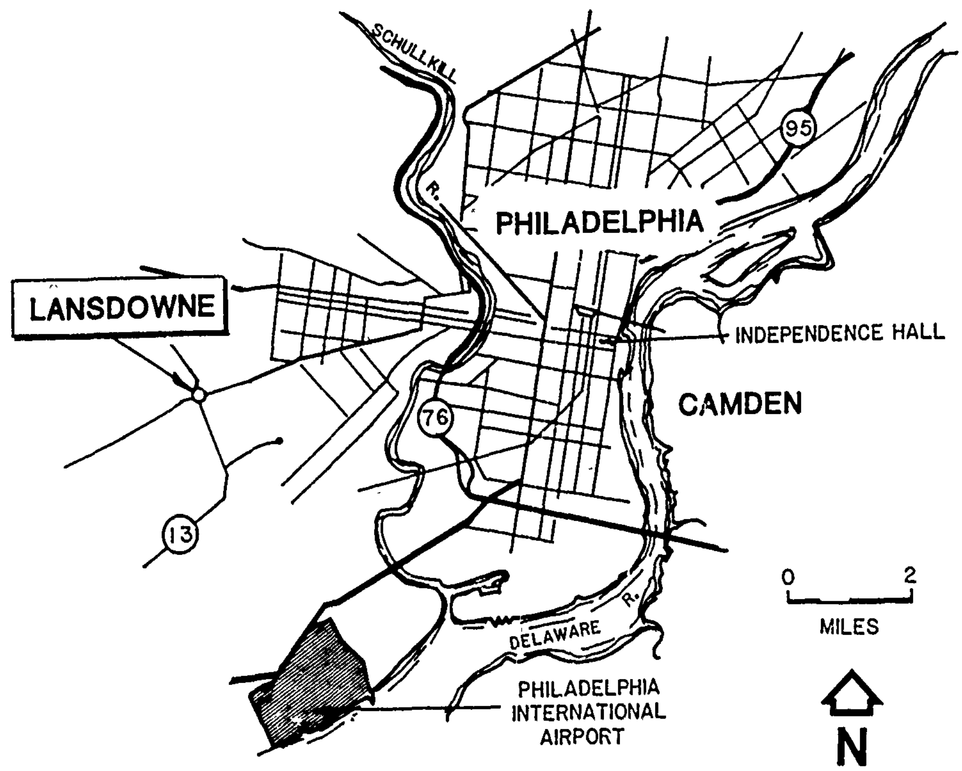

FIG. 1:1 - GENERAL VICINITY MAP

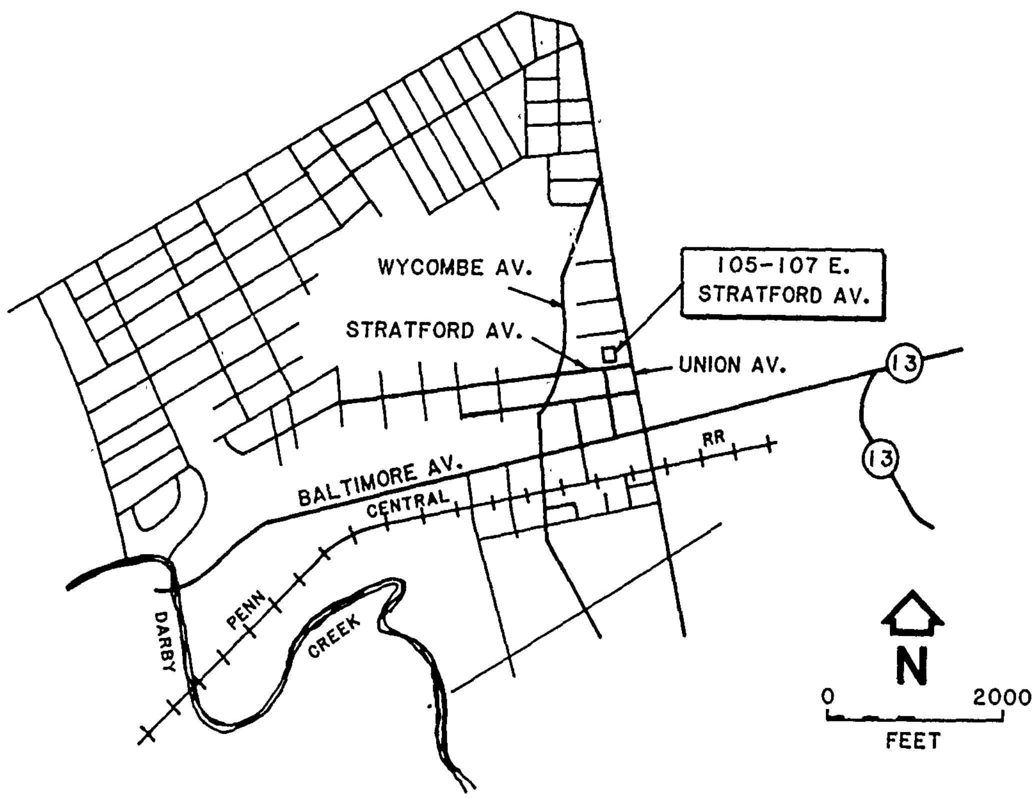

FIG. 1:2 - MAP OF LANSDOWNE AREA SHOWING LOCATION OF STRATFORD AVE. RESIDENCE

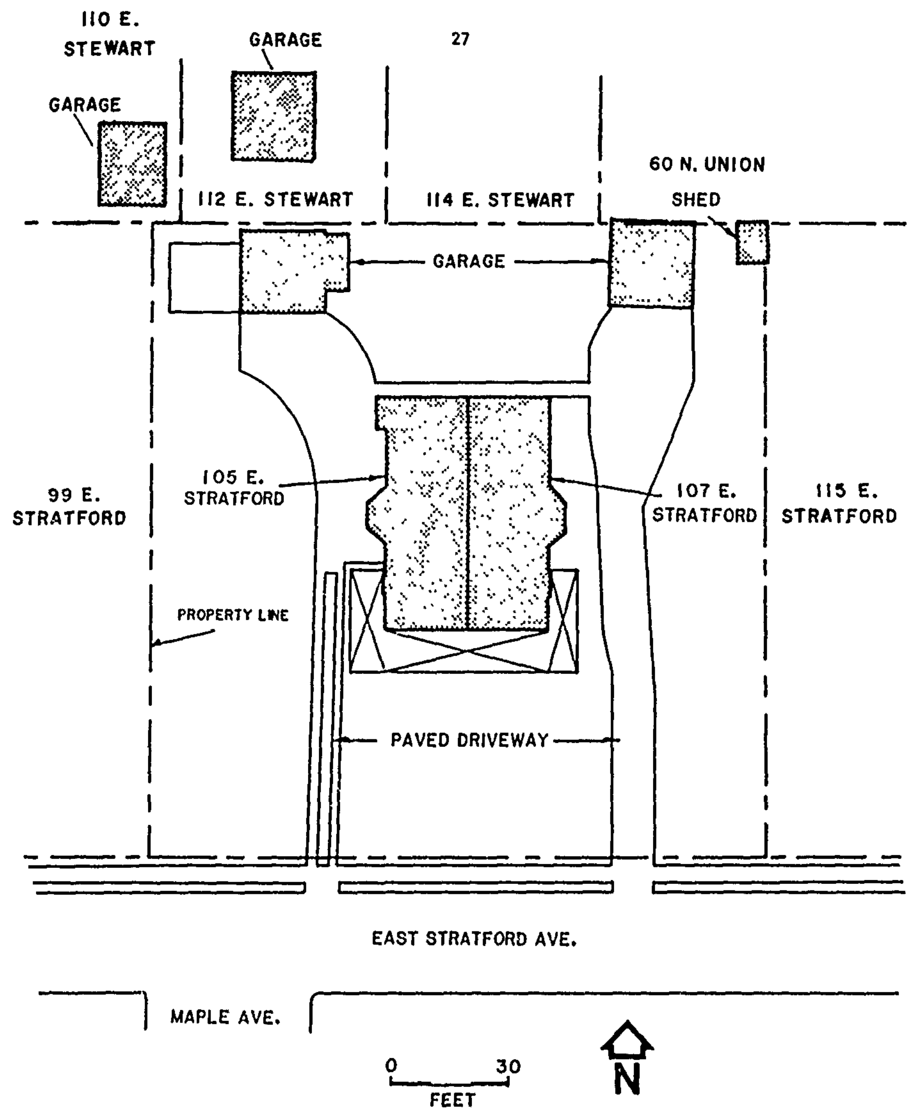

FIG. 1:3 - SITE PLAN

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CHAPTER 2

BACKGROUND

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2.0

BACKGROUND

2.1 How the Site Became Contaminated.

The former house at 105-107 East Stratford Avenue (Fig. 2:1) was built in 1919 as a duplex family dwelling. During the period of 1924-1944, Dr. Dicran Hadjy Kabakjian, a physics professor at the University of Pennsylvania in Philadelphia, reportedly turned the basement of his premises on the 105 side into a laboratory and processing plant for refining radium ore (Fig. 2:2). He used this product in manufacturing radium implant needles for sale to the medical profession in the treatment of cancer patients. Process effluent from the refining process permeated through all parts of the house, including the adjacent 107 side, then occupied by the Charles Groswith family. Kabakjian apparently disposed of liquid waste products from his operation down sinks and toilets, causing extensive contamination of the sewer in front of the house on East Stratford Avenue. Other waste products, such as empty chemical bottles, broken laboratory apparatus, etc., were apparently buried in the yard all around the house, and even in the yards of adjacent property owners, thereby contaminating the soil. The two garages on the 105-107 property also became contaminated, along with the garage on the adjacent 112 E. Stewart Ave. property, directly behind the 105 garage.

2.2 The 1964 Clean-Up.

In 1963, the Pennsylvania Department of Health, acting on information gathered from private individuals, inspected the house and found extremely high levels of radioactivity. In 1964, the U.S. Public Health Service and the Pennsylvania Department of Health made a joint attempt to decontaminate or stabilize the existing contamination in the 105 residence, which had since passed into the ownership of Harry Kizirian. They sanded, vacuumed, scraped off or otherwise physically removed the exceptionally hot spots, sealed the contaminated fireplaces, and fixed locations of lesser contamination under several layers of paint or stucco. This largely eliminated the danger of occupants of the house ingesting loose alpha contamination, but it did not adequately address the problem of an external radiation dose. However, the dose level of gamma radiation in the 105 side of the house, after the 1964 clean-up, had been reduced from approximately 15 rem/year to about 1.5 rem/year, for persons spending around 16 hours per day inside the house. After the decontamination work was completed, the Kizirians resumed living in the house. The 1964 clean-up did not address contamination in the 107 residence, any of the garages, nor in the soil or sewer.

2.3 The 1983 EPA Re-Evaluation.

In 1983, Mr. Kizirian put his property up for sale, at a time when maximum permissible external dose rates for the public had been re-established by the Code of Federal Regulations at 0.5 rem/year. The EPA did a reconnaissance survey of the house and found it to be contaminated under the standards now in effect for total dose. The property was removed from the market, and it was decided to decontaminate it to radiation levels consistent with current regulations. Pursuant to this goal, Argonne National Laboratory was hired to do a radiological assessment to determine the magnitude of contamination and estimate the level of effort required to achieve the EPA goal.

2.4 The 1984 Argonne Radiological Assessment.

Argonne National Laboratory investigated the property during October thru December, 1984, and found contamination above guidelines inside the house and garages, in the sewer in front of the house, and in the soil around the house. In the house and garages, Argonne concluded that no further decontamination was practical, as the radioactivity was deeply imbedded in the walls, floors, and structural members. Argonne recommended that the buildings be dismantled and disposed of at a suitable offsite facility, along with the contaminated soil and sewer. Pending such action, Argonne recommended the installation of an automatic sprinkler system, and this recommendation was duly acted upon by the EPA. Of principal concern to Argonne was the fear of vandalism or fire that could spread the contamination. The unoccupied house posed no immediate radiological hazard to the community, but if it were to ever burn down, contamination could spread to the surrounding community. To eliminate the possibility of such a catastrophe, the house had to be dismantled. Argonne submitted a plan for accomplishing this to the EPA (in July, 1985), at an estimated cost of $3.85 million.

2.5 The 1986 EPA Final Record of Decision.

The site was placed on the National Priorities List, thereby making it eligible for remediation using Superfund money. In its final Record of Decision (ROD) of 22 Sept. 1986, the EPA concurred with the Argonne recommendation that the buildings should be dismantled and disposed of offsite. The Commonwealth of Pennsylvania compensated the duplex owners at fair market value for the structures. The vacant lots would remain properties of those owners.

Fig. 2:1 - Contaminated Residence at 105/107 E. Stratford Ave.
The glassed-in front porch is on the 105-side. The open front porch is on the 107-side. The photo was taken facing northwest, before start of site remediation. August, 1988.

Fig. 2:2 - Former Radium Processing Room in the Basement of the 105 Residence.
The metal drum in the foreground contains radioactive waste left behind from EPA's 1984/85 Emergency Removal Action. There were eleven such drums filled mostly with household chemicals, and they posed a special disposal problem. They could not be sent directly to a radioactive disposal site because they contained both known and unknown chemical liquids. On the other hand, they could not be disposed of at a chemical disposal site because the contents were radioactive. For that reason, they were left in the basement for disposal by the contractor who would later dismantle the house. Photo was taken facing east toward the masonary wall separating the 105 and 107 residences. August, 1988.

CHAPTER 3

SOURCE SELECTION

3.0

SOURCE SELECTION

3.1 Inter-Agency Agreement between the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers.

Following the EPA's final Superfund Record of Decision of 22 Sept., 1986, they elected to exercise an existing inter-agency agreement with the Corps of Engineers for undertaking Federal Lead Projects on their behalf. The Corps of Engineers was tasked by the EPA with preparing, advertising, and awarding a service contract for remediation and restoration of the Lansdowne Radioactive Residence Complex, and also with overseeing the accomplishment of the work in the field. The Corps' design center of expertise for the EPA Region III Office in Philadelphia was the Omaha District. The Baltimore District was the geographical construction district for EPA projects in Pennsylvania. So the design and award phases of the project were handled by the Omaha District, and the remediation and restoration phases of the project were handled by the Baltimore District. A second inter-agency agreement was implemented between the Corps of Engineers and the Department of Energy to have Argonne National Laboratory provide health phsyics support to the Corps throughout the design, award, and remediation project phases.

3.2 Preparation of a Request for Proposal.

The Omaha District contracted with the consulting engineering firm, Sirrine Environmental Consultants, to prepare technical specifications for a Request for Proposal (RFP). These technical specifications essentially told the offerers what kind of product the Government desired and gave them the latitude to propose the means they would use for achieving it. As the people with the knowledge of how to do the job were those who would bid the job, the role of the Government would be to exercise control over safety and the quality of the results achieved. The RFP was advertised in the Commerce Business Daily on 3 Nov., 1987.

3.3 Proposal Review and Award.

Solicitations were obtained by 52 general contractors, subcontractors, and suppliers. By the closing date of 6 March, 1988, six proposals had been submitted by five firms. The proposals were found to be in conformance with RFP instructions to offerers and were given to a Source Selection/Technical Evaluation Board for review. The voting membership of this Board was comprised of a Geotechnical Engineer from Baltimore District, a Chemist and an Industrial Hygienist from Omaha District, and two Health Physicists from Argonne National

Laboratory. The Board Chairman, a Civil Engineer from Omaha District, did not vote. The major areas of consideration in evaluation of the proposals were Technical Provisions/Managerial Expertise, Past Company Experience, Project Scheduling, and Price. Board members were not permitted to see the prices submitted by the offerers until after all proposals had been scored in the other areas of consideration. The proposal receiving the highest overall score was submitted by Chem-Nuclear Systems, Inc., 220 Stoneridge Drive, Columbia, South Carolina 29210. Notice of Award was sent to Chem-Nuclear on 26 April, 1988. The estimated unit-price contract amount was $4,985,397.

CHAPTER 4

PREPARATION, REVIEW AND APPROVAL OF PLANS

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4.0

PREPARATION, REVIEW AND APPROVAL OF PLANS

4.1 Required Plans

The contract required Chem-Nuclear to submit the following plans for review and approval by the COR before they were permitted to undertake certain phases of the work:

Safety, Health and Emergency Response Plan (SHERP)
Contractor Quality Control Plan
Schedule and Critical Path Management Plan
Site Preparation Plan
Remedial Action Plan
Radioactive Waste Management and Disposal Plan
Asbestos Removal and Disposal Plan
Non-Radioactive and Non-Hazardous Waste Disposal Plan
Site Restoration Plan (SRP)
Project Administration and Management Plan
Photography Plan
Environmental Protection Plan
Spill Control Plan
Site Utilities Plan
Site Security Plan
Record Keeping and Data Management Plan
Close-Out Document Provision Plan

All of the plans with the exception of two were reviewed and subsequently approved with only minor revisions. The SHERP merits special discussion, however, because some of its provisions could have caused serious contract disputes even though such never developed.

4.2 Safety, Health and Emergency Response Plan (SHERP).

Disagreements over provisions in the SHERP involved the use of respiratory protection and the wearing of protective clothing and equipment during dismantlement of the house. These were resolved by having the level of respiratory protection and protective clothing for each operation separately established in each Phase Hazard Analysis, thereby allowing for consideration of correct monitoring data. Phase Hazard Analyses are separate documents which the SHERP required the Contractor to prepare for each and every phase of work. The Contractor was required to submit the Phase Hazard Analysis for approval by the Government.

4.2.1 Discussion and Resolution of the Protective Clothing and Equipment Issue.

4.2.1.1 Respiratory Protection.

In his Proposal to the U.S. Army Corps of Engineers, prior to contract award, the Contractor stated the following with regard to respiratory protection.

"A significant difference exists between airborne radioactivity and air concentrations of other hazardous materials that may be found at hazardous waste sites. With the exception of radon (which will be discussed later), airborne radioactivity is normally particulate in nature, not aerosol, and at the Lansdowne Site will exist as the result of work activity and only at the time of that activity, i.e., the radioactive particulate will rapidly settle. Thus, at the beginning of a work period, there will not be airborne Ra-226 since there have been no immediately preceeding work activities to have generated the particulates. In addition, air monitoring can identify airborne radioactivity in real time at concentrations much below safe working levels, i.e., at a fraction of an MPC. This means that the air monitoring program will be able to identify increases in airborne radioactivity caused by dismantlement before levels requiring respiratory protection are reached. Identifying these increases will allow modification of work techniques and implementation of additional engineering controls to maintain air concentrations at safe levels." 5

The significance of the Contractor's Proposal statement on how he would address the matter of respiratory protection did not occur to the Evaluation Board which reviewed the Proposals of the five bidders. Upon re-reading the Chem-Nuclear Proposal, after contract award, it was the feeling of the Government reviewers that levels of airborne radioactivity requiring respiratory protection could conceivably occur instantly, before air monitoring could determine that the Maximum Permissible Concentration (MPC) had been exceeded. Also, air monitoring might not yield representative data, as in the case of a momentary puff of concentrated radioactively contaminated dust generated in front of a worker's face while demolishing the house. In such an instance, it might happen that a worker without respiratory protection would inhale the dust, and the air monitor, perhaps located on the other side the room, might never measure the elevated airborne radioactivity, or if it did indicate the possibility of an intake of radioactive material, it would be too late to do anything about it.

While the Contractor insisted he was presenting his side of the case based on established modes of operation for the radiological industry, including Department of Energy, Nuclear Regulatory Commission, Department of Defense and commercial/industrial applications, he acceded to the concerns of the Government and agreed to provide all personnel working inside the house during dismantlement with air-purifying respirators: full-faced respirators and air-hat respirators. He did this without pursuing any claim for additional costs.

4.2.1.2 Protective Clothing.

With regard to protective clothing, the Proposal stated: "Protective clothing may include but not be limited to respiratory protection, coveralls, gloves, hoods, rubber boots, plastic suits, safety shoes, hard hats, eye protection, hearing protection."

It was the position of the Government (taken after contract award) that certain items of protective clothing on the list were essential and should be provided to the workers by the Contractor as a matter of course. Stating that they "may" be provided did not convey the meaning that they absolutely would be.

After listening to Chem-Nuclear's explanation, the Government was satisfied that it had no intention of cutting costs at the expense of personnel safety or environmental protection, though the wording of the proposal appeared to have opened the door for doing so.

4.2.2 Use of the Phase Hazard Analysis.

The Contractor's first SHERP submission stated the following with regard to the Phase Hazard Analysis:

"Each phase of the project shall be analyzed by the Site Health Physicist and Site Health and Safety Officer to identify potential hazards, radiologic and non-radiologic, and personal protective equipment required. Upon completion, these shall be submitted to ACOE. Further, these analyses shall be conspicuously posted. Each worker is required to be aware of the phase hazard analysis for his/her job task."

Following the 12 July, 1989, Philadelphia meeting, the Contractor agreed to add the key words, "for approval", to the end of the sentence stating that he would submit the Phase Hazard Analysis to the Corps of Engineers. This was a requirement of the Corps Safety Manual, which he was bound by the contract to follow.[6]

As the potential hazards associated with a phase of work had much to do with how the work was to be accomplished, the Government insisted that something be stated about this in the PHA. That way it could judge if the proposed safety equipment was adequate. This could not always be determined from plans like the SHERP. The formal Plans that the contract required the Contractor to submit to the Government for approval, preceding preparation of the PHA, frequently did not nor could not go into technical details on how a phase of work would be executed because little or nothing was known, or decided, about the structural details of the house or the geology of the site at the time the Plans were prepared. But by the time the Contractor prepared a Phase Hazard Analysis, enough information was usually available to go into technical detail

on how the dismantlement or excavation would be carried out. Insisting that the Contractor incorporate such information into the PHA and submit it to the Government for approval, gave the Government one last opportunity to influence the course of work before it was started.

CHAPTER 5

MOBILIZATION/SITE PREPARATION

CHAPTER 5

5.0

MOBILIZATION/SITE PREPARATION

5.1 Scope.

Activities associated with this phase of the job were:

(1) Qualifying personnel for work in the radiation-controlled zone.

(2) Clearing the site of trees and shrubs, and construction of the security fence (Fig. 5:1).

(3) Setting up the jobsite administration area (Figs. 5:2, 5:5 and 5:6).

(4) Setting up continuous air monitoring stations along the site perimeter (Fig. 5:3).

(5) Establishing containment and HEPA ventilation inside the house (Fig. 5:7).

This phase of the project covered the period 1-24 August, 1988. When it was over, the Contractor was prepared to begin interior dismantlement of the house.

5.1.1 Qualifying Personnel for Work in the Radiation-Controlled Zone.

5.1.1.1 Training.

In accordance with applicable sections of 29 CFR 1910.120, all site personnel completed a 40-hour OSHA training course for hazardous waste operations. In addition, all site personnel completed an 8-hour training course on radiological safety tailored to the Lansdowne project and were required to pass a written examination.

5.1.1.2 Physical Examination.

The physical examination to which all site personnel had to submit to prove fitness for work, and/or to meet CNSI company standards, included a chest x-ray, an EKG, a CBC plus differential, a urinalysis, and a pulmonary function test. The purpose of the pulmonary function test was to determine if an employee could breathe without difficulty while working in a negative-pressure, full-face respirator.

5.1.1.3 In-Vivo Monitoring.

Whole-Body Counts (i.e., the identification and quantification of any gamma-emitting radionuclides within a person's body) were conducted on all site personnel before they were permitted to work in the radiologically controlled zone. This initial whole-body count was compared with a close-out whole body count at the conclusion of the job in an attempt to determine if there had been any internal radiation-dose received by a worker as a result of the remediation activities he was involved with at Lansdowne. Both the Government and the Contractor wanted to be sure that in case any site personnel should develop health problems years after the job was over, there would be data to show that the problems either could or could not be attributable to internal radiation exposure incurred on the Lansdowne project. This was a necessary precaution, especially since some site personnel were career radiation workers who may have had bonafide intakes of radioactivity on previous jobs. Based on the findings of the close-out whole body counts, there was no indication that any jobsite personnel had any significant intake of radioactivity. This conclusion is further corroborated by bioassay sampling and evaluation (i.e., urinalysis) which began during jobsite mobilization and continued at monthly intervals all through the phases of site remediation. Personnel bioassay and in-vivo monitoring data appear in the Radiological Closeout Report of the Contractor (Volume 3).

5.1.1.4. Issuance of Badges.

Following successful completion of the training course, physical examination, and the pre-work whole-body count, site personnel were issued identification badges which included their photo. Badges were of two types: red and blue. A red badge authorized an employee access to all site areas during operational and non-operational hours. They were issued to Government employees and the Contractor's managerial staff. A blue badge authorized an employee access to the site only under escort by a red-badged employee, and only during operational hours. Blue badges were issued to subcontractor personnel. Also issued to all jobsite personnel were film badges (thermoluminescent dosimeters) for external exposure monitoring. The TLD's were clipped to the personnel identification badges and never worn off the jobsite (Fig. 5:4).

5.1.2 Clearing the Site.

Tree clearing began along the perimeter of the site to make room for the security fence and progressed inward. In all, 28 tons of tree parts and brush were cut and removed from the site and disposed of as clean rubble in a sanitary landfill. The vegetation on site was sampled, tested, and found to be non-contaminated, even though it was growing in radioactive soil. The outer surfaces of roots, however, were contaminated as a result of being covered with that soil; they were dug up several months later, during soil excavation, and the Contractor was paid for their disposal at the contract rate for contaminated soil.

5.1.3 Setting up the Jobsite Administration Area.

The jobsite administration area had to be located where radiation levels did not exceed the local natural background. Otherwise, the mobile field laboratories of the Contractor and Argonne National Laboratory might not be able to determine that non-radioactive materials, which were the subject of analysis, were in fact non-radioactive. The closest available, background-radiation area to the 105-107 E. Stratford property was the street in front of the house. Facilities in the administration area included a metal, pre-fabricated building, called the Operational Support Facility, which served as a sheltered place to weigh boxes of rad-waste prior to shipment, and also as a place to perform miscellaneous laboratory and decontamination functions such as certifying laundry water for release into the municipal sewer system and decontaminating furniture from the 107 residence. Other facilities included office trailers for the Contractor's staff and the Government Staff, and a crew trailer with clothes lockers, lunchroom facilities and showers for the workers. There was also a mobile home converted to a mobile field lab of Argonne National Laboratory. The administration area was cramped for space by the time all of these facilities were set up and functioning (Figure 5:6).

5.1.4 Continuous Air Monitoring Stations.

Site preparation for remediation activities also involved setting up continuous air monitoring stations (CAMS) on all four sides of the property. These stations continually measured the concentration of radioactive particulates in the air, in the energy range of radium. There purpose was to make sure that dismantlement activities were not producing significant airborne contamination. The CAMS were set to alarm whenever the concentration of airborne radioactive particulates exceeded the maximum permissible concentration (MPC) for Radium-226 established in the Code of Federal Regulations (3.0 E-11 microCuries/milliliter).[7] When the CAMS were activated, a set of written instructions was distributed by the EPA to all residents of the neighborhood advising them of what they should do if the CAMS ever did alarm. Essentially, these instructions told them to close all doors and windows in their house and stay inside until they were notified that the emergency was over. The CAMS never alarmed as a result of exceeding the MPC, so the emergency instructions

never had to be followed.

5.1.5 Establishing Containment and HEPA Ventilation in the House.

In the instructions to bidders, the Government stated that one of the criteria on which their Proposals would be evaluated would be the method for preventing escape of radioactive dust into the atmosphere as a result of dismantlement activities. Chem-Nuclear had proposed to utilize the house itself as a containment. To do this, they would seal off the chimneys, windows and all doors (except one, which would provide access in and out of the building). A 2000 CFM HEPA (High Efficiency Particulate Air) ventilation system would ensure that all air passing through the unsealed access point would flow from outside of the house to inside the house. No contaminated air inside the house would move through the access point in the opposite direction. The CNSI approach proved to be both technically sound and cost/time effective.

On 24 August, 1988, the sealed building was filled with smoke and the HEPA vaccuum was activitated in a test of the Contractor's system. It performed as designed. Following this test, the Government gave CNSI the go-ahead to start dismantling the house.

Fig. 5:1 - Tree Clearing.
28 tons of trees and brush were cleared from the site and disposed of in a sanitary landfill. The roots and stumps, however, were contaminated with radioactive soil and had to be disposed of as rad-waste. Testing determined that there was no uptake by vegetation of radioactive contaminants in the soil. August, 1988.

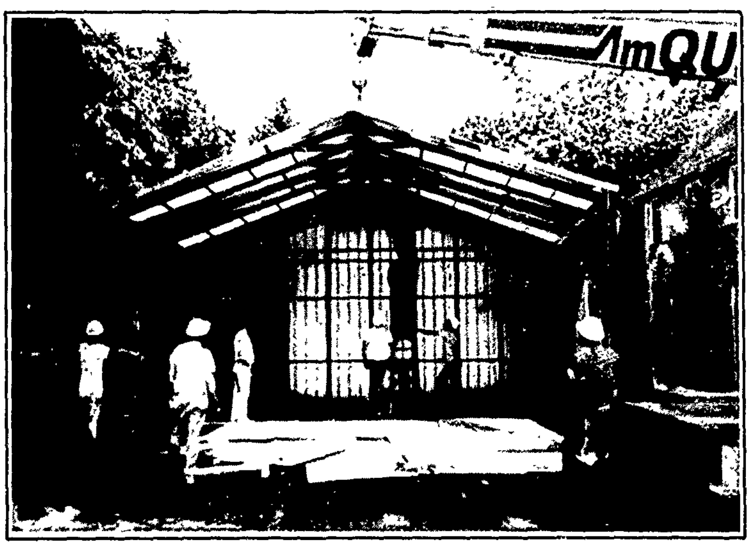


Fig. 5:2 - Assembly of the CSF in the Jobsite Admin Area.
This building served as the frisking station for exiting the radiation controlled zone, as a sheltered area for weighing containers of rad waste, and as a place for general storage of equipment. August, 1988.

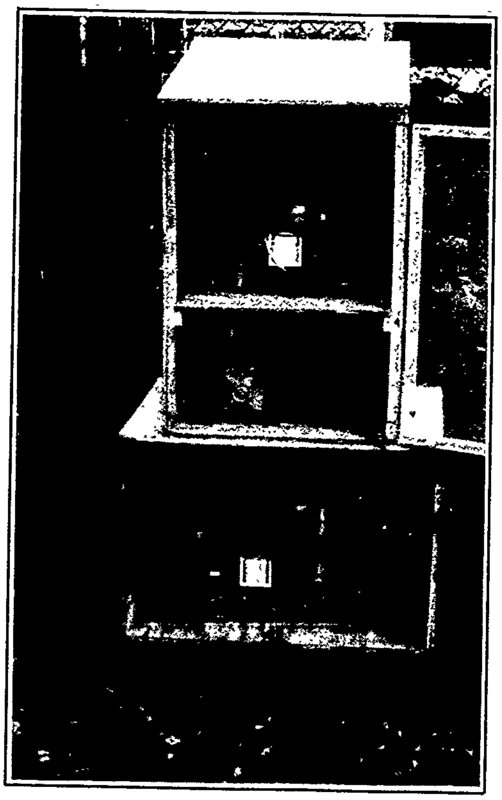


Fig. 5:3 - Continuous Air Monitoring (CAM) Station.
Four such stations were located inside of the security fence to monitor any release of airborne radioactive particulates into the environment as a result of remediation activities. The upper unit monitored alpha emitters, and the lower unit monitored for beta/gamma. If concentrations of radioactive particles in the air ever exceeded the maximum permissible concentration (MPC) established by the Code of Federal Regulations, the bells on the instruments would start ringing and the red lights would start flashing. That never happened owing to a release of radioactivity. However, on one occasion, the CAMS did alarm following a power failure, which was what they were supposed to do. August, 1986.

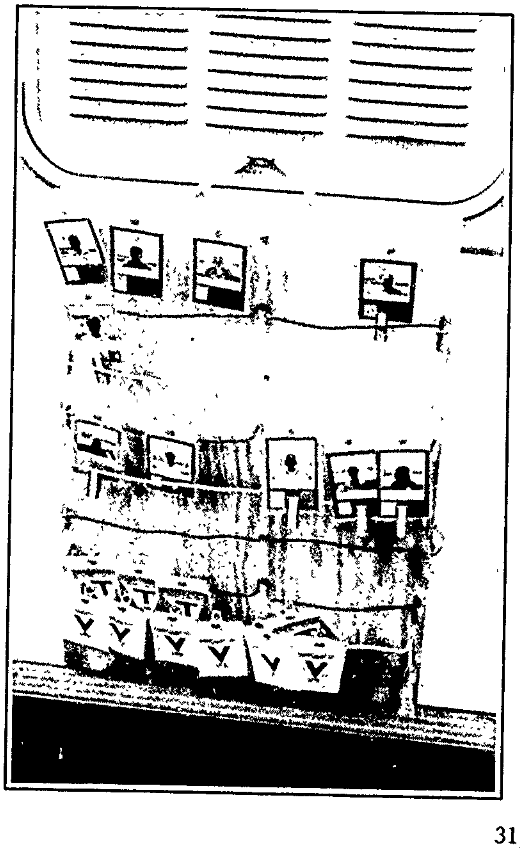


Fig. 5:4 - Personnel Badges.
These badges authorized the bearer some form of access to the site. A red badge permitted unescorted access to all parts of the site at any time of day. These were issued to Government personnel and the CNSI onsite management staff. A blue badge permitted entry only into active work areas during normal working hours. These were issued to permanent subcontractor personnel. Temporary (T-Badges) were issued to transient subcontractors, and Visitor (V-Badges) were issued to visitors. V-Badges and T-Badges required the bearer to have an escort. Personnel whose work activities required them to spend prolonged periods in the exclusion zone were additionally issued thermoluminiscent dosimeters (TLD's) which were clipped to the bottom of their badge. Badges were surrendered to the security guard at the main gate before exiting the jobsite, August, 1986.

Fig. 5:6 - E. Stratford Ave., Following Jobsite Mobilization.
Jobsite administration area now occupies the street in front of the house. This was the only low-background radiation area on the jobsite, so the administration area could go no other place. The Government office trailer is at far left; the CNSI office trailer is in center rear; and the crew trailer is at center right. The prefab metal building at far right is the Operational Support Facility. The OSF and all trailers with the exception of the Government trailer had to be subsequently moved about 8 months after this photo was taken in order to access the contaminated sewer and patches of contaminated soil under the street. When it came time to move the trailers, the Contractor returned them to the rental agency because he was able to set up operations in a rented house two doors away at 115 E. Stratford Ave. Photo taken facing south from front porch of the contaminated 107 residence. August, 1988.

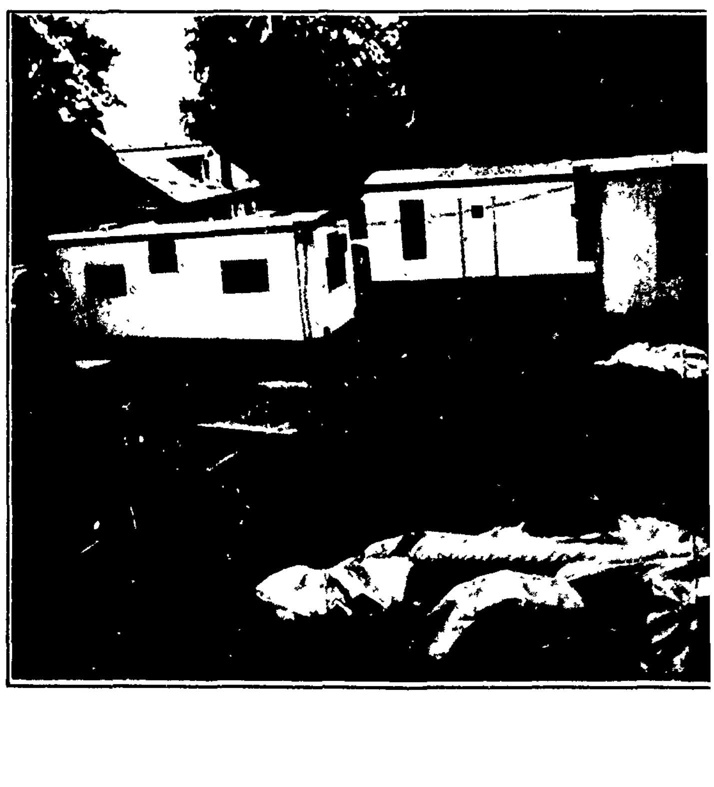
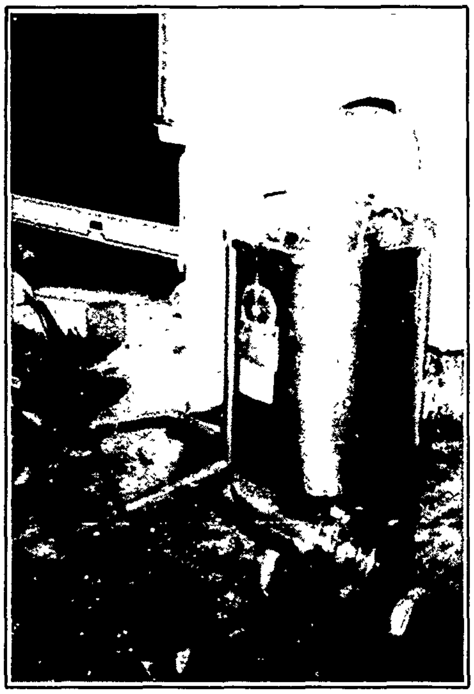


Fig. 5:5 - E. Stratford Ave. Residential Neighborhood Prior to Jobsite Mobilization.
Photo taken facing south from the front porch of the 107 residence.
July, 1988.

Fig. 5:7 – HEPA Ventil
During dismantlement
prevent the release of
windows with flexible
the upper-level rooms
exhausted filtered air t
exhausted into the firs
(2000 cfm) HEPA unit l
before exhausting it in
exhaust port of the ma
environment containec



a. 500 cfm HEPA unit in upper-level room about to undergo interior dismantlement.

b. Hole in upper-level floor through which the duct from a 500 cfm HEPA unit ran to the first floor of the house.

c. First floor living room into which HEPA filtered air was exhausted from rooms on tl undergoing interior dismantlement. Duct passing through window at right draws filter to the main 2000 cfm HEPA unit located on the porch outside the house.

Fig. 5:7 - HEPA Ventilation System.
During dismantlement of the house, the Contractor elected to use the building itself as a containment structure to prevent the release of radioactive particulates into the environment. This involved first sealing all doors and windows with flexible plastic sheeting and duct tape. A small (500 cfm) HEPA vacuum unit was then activated in the upper-level rooms of the house where dismantlement was underway. The 500 cfm HEPA's on the upper floors exhausted filtered air through a duct passing through a hole in the floor down to the first floor living room. The air exhausted into the first floor living room was then drawn through a duct passing through a window to the main (2000 cfm) HEPA unit located outside the house on the 107 front porch. The main HEPA unit filtered the air again before exhausting it into the atmosphere. A CAM (Continuous Air Monitoring station) was placed beneath the exhaust port of the main HEPA to verify that all air from inside the house that was being exhausted into the environment contained no radioactive particles. August, 1988.

HEPA filtered air was exhausted from rooms on the upper levels of the house Duct passing through window at right draws filtered air exhausted into the room cated on the porch outside the house.

d. Main 2000 cfm HEPA vacuum located on the 107 front porch outside the house.

CHAPTER 6

DISMANTLEMENT

CHAPTER 6

6.0

DISMANTLEMENT

6.1 Magnitude.

Structures which were dismantled and disposed of as contaminated rubble included the 105/107 E. Stratford Ave. duplex residence; the 105 and 107 garages; sidewalks, driveways and slabs on and immediately adjacent to the 105/107 property; and the garage of John Townsende at 112 E. Stewart Ave. In all, approximately 1430 tons or 46,698 cubic feet of rubble, filling 460 metal B-25 boxes, were generated from the dismantlement of these structures. It took 77 tractor trailers to transport the rubble to the Envirocare disposal site in Utah.

6.2 Schedule of Dismantlement.

Structures or their appurtenances were dismantled in the following order and during the dates provided:

(1) 105/107 building interior.
(25 August-5 October, 1988)

(2) 105 garage.
(6-8 October, 1988)

(3) Exterior walls of the 105/107 residence, down to the first floor.
(10 October-21 November, 1988) (Figs. 6:1 and 6:2)

(4) Basements of the 105/107 residence.
(1-27 February, 1989)

(5) 107 garage.
(23 February-1 March, 1989)

(6) Garages at 110 and 112 E. Stewart Ave.
(18-21 April, 1989)

(7) Driveways, slabs and sidewalks.
(2 March-6 May, 1989)

6.2.1 Dismantlement of the 105-107 Building Interior.

The contract required dismantlement piece-by-piece utilizing hand labor. That was how interior building dismantlement, and for that matter the dismantlement of all contaminated structures and their appurtenances, was accomplished. Nothing was demolished, in the sense of taking a wrecking ball to it. The work of dismantlement was performed by 10 laborers, employed by the subcontractor, Carlucci Construction Company. Interior dismantlement began on the 3rd floor of the 105-side and progressed floor-by-floor down to the basement of the 105-side. The interior of the 107-side was next removed in similar sequence. The workers would knock the plaster off the interior walls, strip the wood laths off the wall studs, remove the studs, and finally take up the floor boards. All rubble was hand-carried down to the back porch of the 105-side, where it was passed through a window to workers inside the packaging containment, located outside the house. There it was neatly packaged into the B-25 boxes to attain maximum possible weight per box volume. Maximizing the packaged density of the rubble was of utmost importance to CNSI, since the unit of payment for rubble was per ton, while his disposal cost was based on volume. When interior dismantlement was complete, what could still be seen inside the house were the interior sides of the stone walls, the stairwells which were not dismantled, the roof and rafters, floor/ceiling joists, and the automatic sprinkler system. At the Government's insistance, the sprinkler system remained intact and activitated during interior dismantlement because there was still combustible material inside the house when this phase of work was complete. The sprinkler system was subsequently dismantled floor-by-floor during exterior building dismantlement (Figs. 6:3 and 6:4).

6.2.1.1 Decontamination of Furniture, Appliances and Personal Effects.

Contaminated furniture, appliances, etc., belonging to Mrs. Nancy Louderback, were left in the 107 residence when she re-located in 1984. The Contractor was required to attempt to decontaminate these items for the owner, which he did concurrently with interior dismantlement of the 107 side. Approximately 20 pieces of antique mahogany furniture were carried from the house down to the OSF and successfully decontaminated by removing the finish with isopropyl alcohol (Figs. 6:5 and 6:6). Stuffed furniture, most appliances and paper items such as legal documents, scrapbooks, photographs, etc., could not be decontaminated without ruining them, so they were disposed of as radioactive waste. However, 68 shares of AT&T stock, purchased in 1925 by Mrs. Hanna Groswith, were able to be saved. These were handed over to the EPA for return to the property owner. (Fig. 6.7).

6.2.1.2 Asbestos Removal.

Approximately 20 feet of asbestos-insulated hot-waterpipe were discovered in one room of the 107 basement. This was removed in a small-scale, short-duration operation performed by the Site Health & Safety Officer, assisted by a specially trained laborer. The work was done after normal working hours to further reduce the risk of asbestos exposure to other site

personnel. The asbestos insulation was sprayed with a water-detergent emulsion and wrapped in 6-mil polyethelene plastic. The pipe lagging was then cut into 5-foot lengths, labeled with asbestos-warning signs, and disposed of in a B-25 box with radioactive waste. Protective clothing and equipment worn for the asbestos removal operation (with the exception of full-face respirators) was disposed of as rad-waste.

6.2.2 Dismantlement of the 105 Garage.

6.2.2.1 Scheduling.

B-25 boxes filled only with wood did not have enough weight to balance the Contractor's disposal costs. But he discovered that if he filled a B-25 box 1/3-full with light-weight wood and the remainder with heavy-weight brick and stone the box would then have enough weight to make disposal profitable. The problem was that, during the stage of exterior building dismantlement, the volume of wooden rubble generated from joists, rafters, and other structural timbers, far outpaced the volume of brick and stone rubble generated from dismantling the walls of the house. So in order to fill the B-25 boxes only 1/3-full with wood he would have to stockpile them on the site until he generated enough brick and stone rubble to finish filling them. The jobsite was cramped for space, but the area of the 105 garage slab afforded a potential storage area for the partially filled boxes. So on 6 October, 1988, the Contractor briefly interrupted his dismantlement operations on the 105-107 residence to have his workers take down the 105 garage.

6.2.2.2 Procedures.

Dismantlement of the 105 garage was preceded by a radiological survey of the structure. The purpose was to assess the level of contamination and thereby determine the extent of controls that would be required to contain the radiation as the building was being dismantled. The survey identified hot spots exhibiting up to 17 milli-R/hour, which would give a person his yearly dose limit of 500 millirem after about 29 hours of exposure. The building was sealed and these hot spots were selectively scabbled out of the concrete floor or cut away from the wooden walls and rafters. Following this remediation, radiation dose levels had been reduced to under 100 micro-R/hour, which, by site criteria, qualified the garage to be dismantled under a tarpaulin. Dismantlement started by removing the roof, followed by the wooden siding on the walls. Finally the roof joists, beams and wall uprights were removed. Dust suppression was achieved through the utilization of water spray, HEPA vaccuums for cleaning up loose materials, and local area HEPA exhaust ventilation. The concrete floor slab was left as a staging area for B-25 boxes.

6.2.3 Dismantlement of Exterior Residence-Walls down to the 1st Floor.

The contaminated duplex was not dismantled from roof to basement in one stage. Dismantlement took place in two stages: first the exterior walls were taken down to the floor boards on the first floor, then following a period of several weeks during which the Contractor pursued soil excavation, the remaining basement sections were taken out.

6.2.3.1 Preliminary Investigations.

No engineering drawings showing how the house was designed and constructed were available to the Contractor. Therefore, plans for exterior dismantlement could not be finalized until the structural components of the house had been exposed by removal of the interior walls and thoroughly studied. For this study, the Government required the Contractor to obtain the services of a professional structural engineer. Also, provisions for containing airborne radioactive particulates generated by dismantlement could not be finalized in the Phase Hazard Analysis until the radiation experts had been given the opportunity to assess the level of contamination on the inside of the stone walls. Thus a structural engineering analysis and a radiological survey had to precede dismantlement.

6.2.3.1.1 Structural Engineering Analysis.

In the initial Phase Hazard Analysis submitted to the Project Engineer for approval, the Contractor proposed to first dismantle the 105 side of the building and then address the 107 side. Before approving this plan, the Project Engineer asked the Contractor to have a structural engineer inspect the gutted building interior and give his expert opinion on whether the Contractor's plan was suitable. After his inspection, the structural engineer, from Catania Engineering Associates, concluded that if the Contractor were permitted to follow through on his dismantlement plan, the result would be the creation of a freestanding fire-wall, over 30 feet high and only two bricks wide; it would be highly unstable because it was not tied into the exterior stone walls of the house. The structural engineer recommended instead that the house be taken down in a spiral, by going around the walls and removing one layer of brick and stone at a time. With slight modification, this was the manner in which the exterior walls of the house were dismantled.

6.2.3.1.2 Design of Bracing for the Firewall.

The problem posed by taking the house down in a spiral was that the workers would have to be constantly climbing back and forth over the firewall separating the two residences. To eliminate that obstacle, the Contractor

proposed that the firewall be braced on both sides, starting on the third floor, and that the three exterior walls on the third floor of the 105-side be dismantled by going around the walls and removing one layer of stone at a time. When the walls on the third floor of the 105 side were so dismantled, down to a height of 4 feet above the floor joists, he would then go over to the third floor of the 107-side and dismantle the four walls (including the fire wall) by removing one layer of brick and stone at a time. The procedure would be repeated on succeeding lower floors of the house. The four feet of stick-up left on the exterior walls at each floor level would serve as a barrier to prevent workers from falling. Based on a toppling analysis of the fire wall, considering design wind-loads for the Philadelphia area and forces exerted on it by the exterior stone walls of the house, the Government concluded that not more than three feet of fire wall should be left free-standing above the bracing system. The Government approved the Contractor's proposal, contingent upon the construction of a firewall bracing system (Appendix A). [8]

6.2.3.1.3 Radiological Survey.

As with dismantlement of the 105 garage, a preliminary radiological survey was undertaken on the house for the purpose of determining the level of containment required to prevent the escape of the airborne radioactive particulates that would be generated by dismantlement activities. This survey identified hot spots having radiation levels greater than 100 micro-R (gamma) per hour, which were removed under local air-lock type containments. Following this, a tarpaulin cover over the walls, with HEPA exhaust ventilation under the cover, was found to be adequate to contain any other contamination that might be released into the air as a result of dismantlement operations. That this was adequate was verified by environmental air monitoring (away from the house) while exterior building dismantlement was underway. (See attached ANL and CNSI reports).

6.2.3.2 Procedures.

6.2.3.2.1 Roof and Third Floor Dismantlement (Fig. 6:8).

Dismantlement began on the 105 side and proceeded as follows:

(1) 3/8-inch plywood sheets were secured to the floor joists with nails to form a temporary flooring to support workers and scaffolding.

(2) Workers on the outside of the roof then removed enough slate shingles to expose a roof area of approximately one square foot.

(3) Workers on scaffolding inside the house breached the roof with a saw at the point where the shingles were removed.

(4) The slate shingles were passed into the third floor level and the roof opening was expanded to approximately four feet by four feet.

(5) A tarpaulin was spread over the roof exterior. Through the hole in the roof, a 12-foot pole was inserted to pitch the tarpaulin clear of the roof exterior and thereby give the workers room to work under the tarp while they removed the remainder of the roof shingles.

(6) The roofing boards and beams were removed following removal of the roofing shingles. These were cut and fitted as bracing for the fire wall.

(7) The dismantlement of the third-floor exterior walls then proceeded in approximately one-foot vertical increments, until the walls were lowered to a height of approximately 42 inches above the third-level temporary flooring.

Steps 1 - 7 were repeated on the 107-side, except in this case, the Contractor took out the brick fire-wall along with the exterior stone walls in one-foot vertical increments. After completing the lowering of exterior walls on the third-floor level of the 107- side, the temporary plywood flooring on both sides of the residence was taken up.

6.2.3.2.2 <u>Second Floor Dismantlement.</u>

Dismantlement began on the 107 side and proceeded as follows:

(1) Temporary plywood flooring was established.

(2) The tarpaulin was adjusted to adequately cover exterior walls.

(3) The fire wall was braced.

(4) Scaffolding was erected and the ceiling joists (formerly the floor of the third story) were removed.

(5) The exterior walls were lowered in one-foot vertical increments to a height of approximately 42 inches above the temporary flooring. The rubble was dropped down a chute to the first floor and from there carried to the packaging containment.

Steps 1 - 5 were repeated on the 105-side, with the inclusion of the interior fire wall among the walls that were lowered. The second floor stairway on the 105-side had radiation levels above the jobsite standard of 100 micro-R/hour, and therefore had to be dismantled within a sealed containment. (100 microR/hour was a locally adopted action level requiring the most conservative radiological controls--i.e., sealed containments, to ensure against the release of radioactive particulates into the environment.) Following lowering of walls on the second-floor level of the 105- side, the temporary flooring at the second-floor level on both sides of the residence was taken up.

6.2.3.2.3 First Floor Dismantlement.

The work began on the 107 side and proceeded as follows:

(1) Dismantlement of the front porch in the open air. This was sufficient as radiation levels were below 50 micro-R/hour.

(2) Adjusting the tarpaulin cover over the exterior walls.

(3) Bracing the firewall.

(4) Removal of ceiling joists (former floor of the 2nd story).

(5) Lowering of the exterior stone walls in one-foot vertical increments down to the original oak flooring.

(6) Removal of spotty contamination on the flooring and patching holes in the flooring. created by such removal, with pieces of plywood.

(7) Covering the flooring with several layers of 6-mil polyethylene plastic to prevent rain from leaking through the flooring into the basement.

These procedures were repeated on the 105 side, with the exception that the chimney walls and first floor stairway were dismantled within sealed containments, as they were contaminated above the 100 micro-R/hour level.

6.2.4 Dismantlement of Basements (Fig. 6:9).

Dismantlement of the 105 and 107 basements followed a 9-week break in house dismantlement, during which time the Contractor pursued the excavation of contaminated soil around the house. The reasons for taking time out to

excavate soil were three:

(1) Before soil excavation could proceed at production rates, COE, ANL and CNSI wanted to conduct an experiment to determine how accurately excavation quantities of contaminated soil could be estimated. Excavation of a small plot of soil behind the house by the Contractor was part of that experiment. See Chapter 7 for additional details.

(2) Based on the results obtained from excavating the experimental plot, the Contractor developed and implemented a more economically balanced approach to disposing of the relatively light building rubble and heavier soil and basement rubble.

(3) Excavation of contaminated soil around basement walls before basement dismantlement would mean that this would not have to be done concurrently with basement dismantlement. The Contractor would thus be free to pursue basement dismantlement non-stop, without having to address such things as high, steep slopes in the soil, left behind as the walls of the basement were removed.

6.2.4.1 <u>107 Basement Dismantlement.</u>

The basement on the 107-side of the house was addressed first. Dismantlement activities proceeded as follows:

(1) Standing water on the basement floor was pumped into containers, analyzed for radioactivity, and discharged into the municipal sewer after activity was found to be below the maximum permissible concentration established by the Code of Federal Regulations.

(2) The remaining part of the fire-suppression system within the 107 structure was dismantled. The 1000-gallon water bladder was drained and the water disposed of in the same fashion as the standing water on the basement floor.

(3) The basement was thoroughly surveyed and areas identified with a dose rate greater than 50 micro-R/hour were remediated using the existing structure as a containment with local HEPA exhaust ventilation applied.

(4) A breach was made in the south (front) basement wall, through which rubble would be passed into a front-end loader that would transport it over to a B-25 box for packaging in the open air.

(5) The basement ceiling (former floor of the first story) was dismantled in order to gain access to the walls. The walls were dismantled in one-foot vertical increments, utilizing pneumatic hand tools, until they had been lowered to the level of the concrete floor slab. This was permitted without a

tarpaulin covering or HEPA ventilation because radiation levels inside the structure no longer exceeded 50 micro-R/hour.

(6) Lastly, the concrete floor slab was taken up.

6.2.4.2 <u>105 Basement Dismantlement.</u>

Dismantlement of the 105 basement proceeded as follows:

(1) The remaining part of the fire suppression system was dismantled and the water bladder drained.

(2) A wood-frame containment was constructed over the four basement walls with HEPA exhaust ventilation established inside.

(3) An 8' x 8' hole was cut in the ceiling of the center section of the basement to expose one of the rooms that would serve as the packaging area for the B-25 boxes. This room was sealed off from the rest of the basement with 6-mil polyethelene plastic when filled B-25 boxes were lifted out through the hole in the roof.

(4) The ceiling (first-floor joists) over the section of basement north of the packaging room was removed and the north section walls were taken down in one-foot vertical increments to the floor slab. The floor slab was then removed.

(5) The ceiling over the section of basement south of the packaging room was removed, and the south section walls were taken down in one-foot vertical increments to the level of the floor slab. This was followed by removal of the floor slab.

(6) The walls of the packaging room in the center section of the basement were taken down in one-foot vertical increments to the level of the floor slab, and the floor slab was removed.

(7) The tent-like containment over the former 105 basement was struck and disposed of as rad-waste.

6.2.5 Dismantlement of the 107 Garage.

The 107 garage was a two-story, wood-frame structure, contaminated on the upper floor and non-contaminated on the lower floor. The distribution of the contamination enabled the Contractor to utilize the first floor as a covered storage area. For this reason, the garage was not dismantled until the last possible moment when it had to go to permit the excavation of contaminated soil underlying it. Dismantlement was carried out in the open air, without tarpaulin covering or HEPA ventilation, as radiation levels were below 50 micro-R/hour. However, workers performing the dismantlement wore protective gloves, boots and coveralls, and air-hat respirators, in accordance with jobsite safety criteria.

6.2.6 Dismantlement of Garages at 110 and 112 E. Stewart Ave.

Before the beginning of site remediation, it had been expected that the work would probably extend outside the boundaries of the 105-107 E. Stratford property and affect structures on adjacent properties. Finding out the specifics of what such adjacent property work would encompass had to await the onset of remediation. It turned out that two garages located directly behind the 105 Stratford lot had to go, but for different reasons.

The 110 Stewart garage was not contaminated. It had to be removed because it was located immediately beside an area where contaminated soil would have to be excavated to a depth of over 10 feet. The structure had undergone severe differential settlement over the years, and it was felt that it would probably collapse as a result of the pending deep excavation, despite whatever attempts might be made to keep it standing by bracing, underpinning, etc. Since the structure was not contaminated, it was demolished with a Poclain trackhoe, instead of being dismantled piece-by-piece like the house.

The 112 Stewart garage was contaminated (on the inside), so it was dismantled piece-by-piece. Contamination levels were low (under 50 micro-R/hr.), so it was dismantled in the open air, without tarpaulin covering or HEPA ventilation, The workers still wore respiratory protection and protective clothing against personal contamination, and there was no evidence of such contamination afterwards. How the 112 Stewart garage became contaminated is a mystery.

6.2.7 Dismantlement of Driveways, Slabs and Sidewalks.

These were dismantled in the course of soil excavation, as they were enveloped by the expanding area of the excavation. The rubble generated was contaminated by the 2-Sigma criterion (see below) and boxed and disposed of seperately from contaminated soil. This rubble also included any basecourse materials under the pavement. The contract provisions did not spell out the criteria for distinguishing soil from rubble, so the Government and the Contractor agreed to

classify any structural fill as rubble. All other objects in the soil, such as naturally occurring rocks, discarded man-made debris, and roots of trees, would be classified as soil and payment for their disposal made accordingly.

6.3 Contamination Criteria.

Contamination criteria for rubble generated by dismantlement, and for establishing various levels or degrees of containment to prevent atmospheric contamination, was based on published guidelines of regulatory agencies in situations where such were applicable. Where no regulations or guidelines could be found to fit particular situations, conservative site-specific criteria were improvised.

6.3.1. Release Criteria for Rubble Specified in the Contract.

Contamination criteria for rubble, provided in the instructions to bidders, was given in terms if disintegrations per minute (dpm) on a 100 square centimeter surface for the alpha emitters of interest: Ra-226, Th-230, Pa-231 and Ac-227. [9]

Average	Maximum	Smearable
100 dpm/100 sq. cm.	300 dpm/100 sq. cm.	20 dpm/100 sq. cm.

The DOE regulation states: "These guidelines are adapted from standards of the U.S. Nuclear Regulatory Commission (NRC 1982) and will be applied in a manner that provides a level of protection consistent with the Commission's guidance." Both the NRC 1982 document and NRC Regulatory Guide 1.86 (USAEC 1974) make the following conditions:

(1) "Radioactivity on equipment or surfaces shall not be covered by paint, plating or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified...prior to the application of the covering."

(2) "Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits."

6.3.1.1 Minimum Detetectable Activity Criterion.

Following contract award, the Contractor and the Government set an additional contamination criterion for rubble at the Mimimum Detectable Activity (MDA) above background that could be detected by gamma survey instruments. This criteria may have resulted in some materials (i.e., bricks, granitic rocks, etc.) being classified as radioactive waste owing to the presence of naturally occurring radionuclides. However, since the only true measure of contamination in rubble was in pCi/g, for which there was no practical way of determining given the exigencies of site remediation, and given the potential for missing some contamination if a higher activity level detected by gamma survey was used, the MDA criterion was judged to be conservative and relevant. [10]

6.3.2 Contamination Criteria for Establishing Radiological Controls.

In the course of interior building dismantlement, while the sealed house was being used as a containment, it was found that where fixed contamination in the wood and plaster never exceeded 50 micro-R/hour, the concentration of airborne radium never exceeded the MPC of 3.0 E-11 micro-Curies/milli-liter after it had been given time to disperse around the room, even in the absence of HEPA exhaust ventilation. It was also found that where fixed radiation levels exceeded 100 micro-R/hour, the concentration of airborne radium always exceeded the MPC, even in the presence of HEPA exhaust ventilation. On subsequent dismantlement activities, these findings were used to establish the required type of containment measures for the structure undergoing dismantlement. Where fixed contamination levels were under 50 micro-R/hour, no containment provisions were implemented, though workers still wore full-face or air-hat respirators as protection against momentary puffs of concentrated radioactive dust in front of their face. Where fixed contamination was 50 - 100 micro-R/hour, the structure undergoing dismantlement was covered with a tarpaulin and HEPA exhaust ventilation was applied. Though daylight was visible under the edges of the tarpaulin, negative air-pressure under the tarpaulin, created by the HEPA unit, was able to prevent the escape of radioactive dust to the outside. Where contamination was in excess of 100 micro-R/hour, the structure was dismantled within an air-lock type of containment. That, combined with HEPA ventilation, made doubly certain that no radioactive air escaped into the environment.

6.4 Processing Radioactive Rubble for Disposal.

It took about 5 times longer to generate a ton of rubble from house dismantlement than it did to produce a ton of soil during contaminated soil excavation. This afforded the Contractor plenty of time to get the boxes of rad-waste loaded and ready for shipment--a job that involved neatly packaging of the contents to maximize the weight/volume ratio, checking the outsides of the boxes for loose contamination and decontaminating them before they were brought out of the exclusion zone, weighing the boxes on a certified scale, determining the external dose produced by each box for statement on the

shipping manifest, and finally making arrangements with a trucking company to haul the boxes away. Photographs of these activities appear in Figs. 6:10 and 6:11, at the end of the Chapter.

Fig. 6:1 - Jobsite Facing East from 99 E. Stratford Ave., Prior to Exterior Building Dismantlement.
August, 1988.

Fig. 6:2 - Jobsite Facing East from 99 E. Stratford Ave., After Exterior Building Dismantlement Down to the Basement Ceiling.
December, 1988.

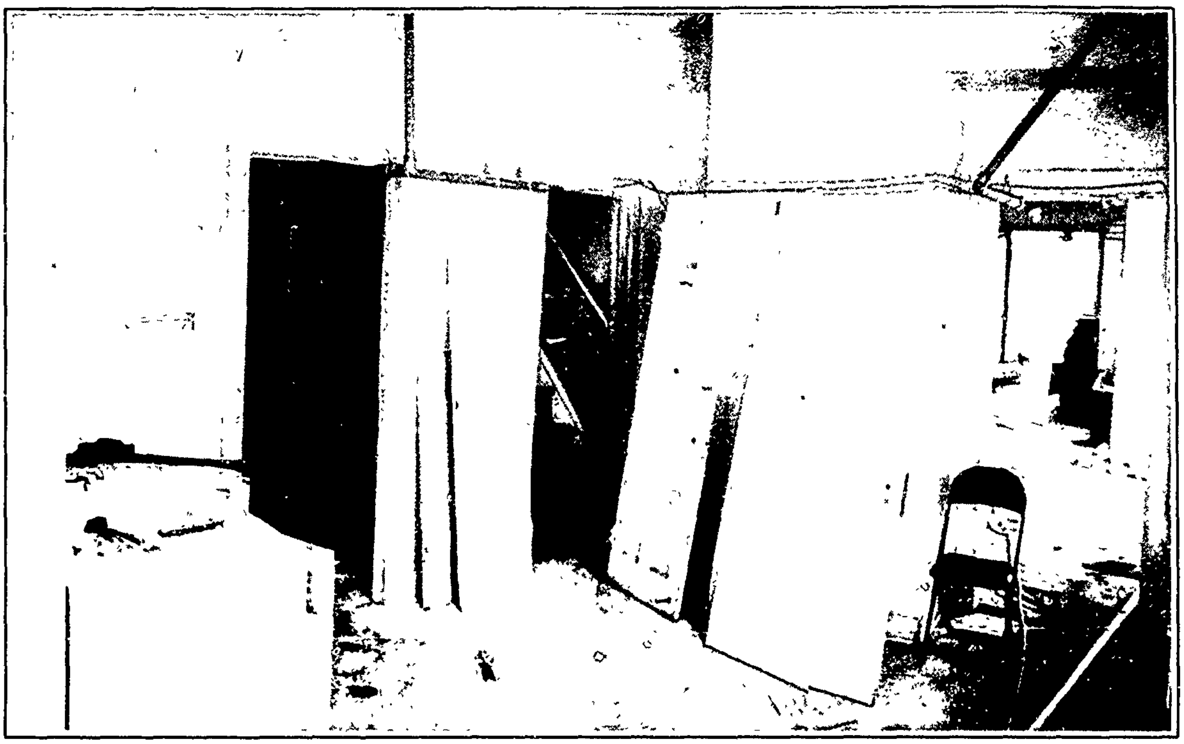


Fig. 6:3 - Firs
Dismantleme
Photo was ta
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front door of
1989.

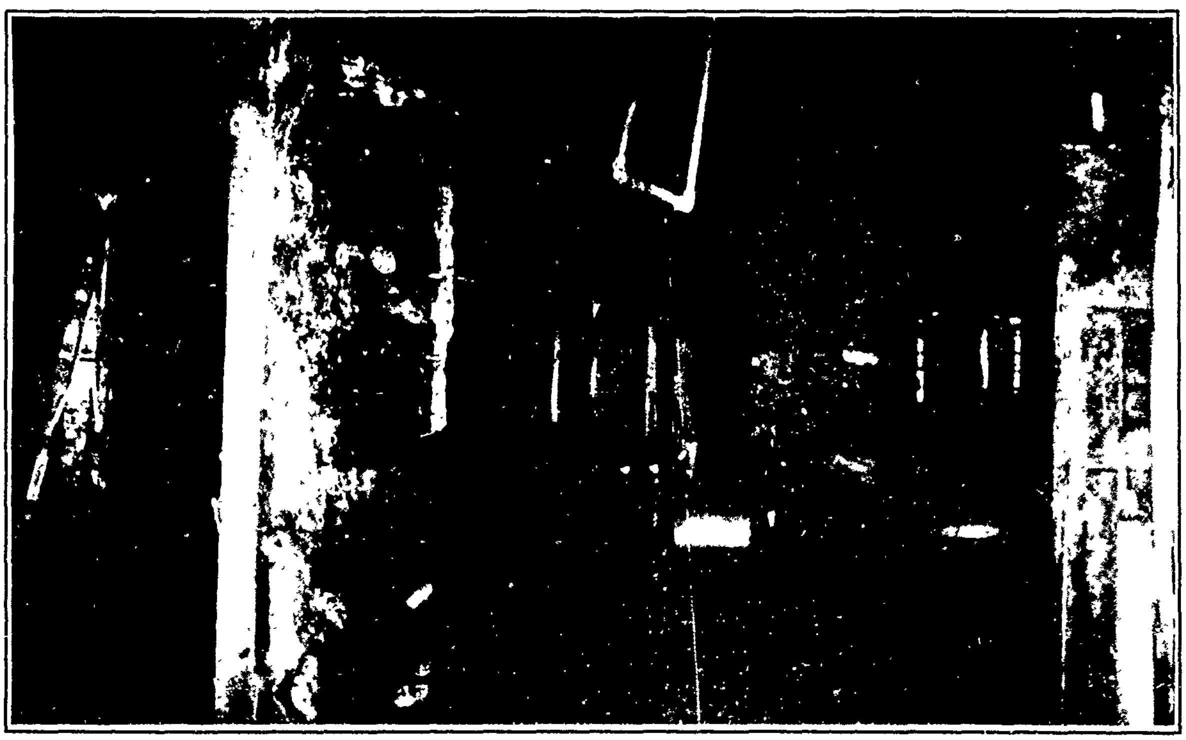


Fig. 6:4 - Firs
Dismantleme
Photo was ta
above. The pl
reveal the bric
piping overhe
system which
exterior walls
considerable
house. Septen

Fig. 6:3 - First Floor, 105 Side, Prior to Interior Dismantlement.
Photo was taken standing in the kitchen facing south through the dining room and into the living room. The front door of the house is in the far background. August, 1989.

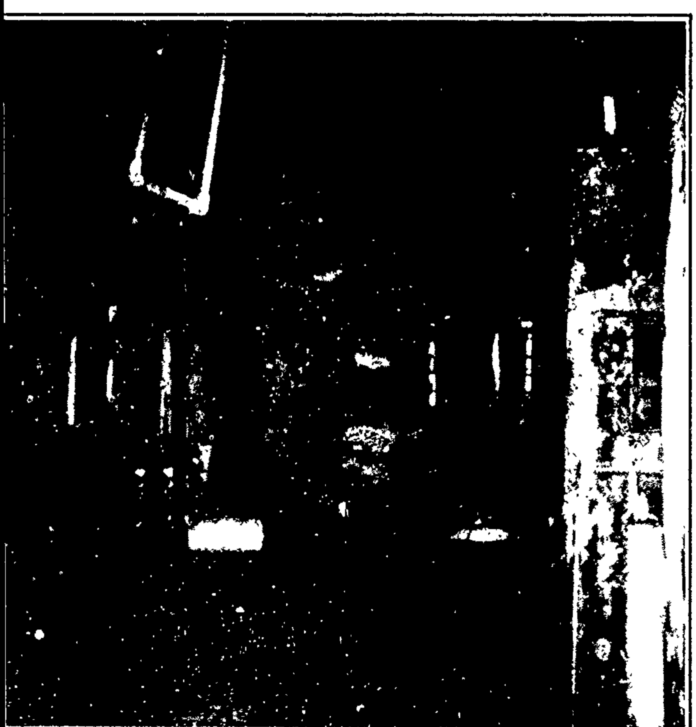


Fig. 6:4 - First Floor, 105 Side, After Interior Dismantlement.
Photo was taken from same perspective as Fig. 6:3 above. The plaster interior walls have been removed to reveal the brick and stone structural walls. The grey piping overhead is part of the automatic sprinkler system which was left operational until the first floor exterior walls were dismantled, as there was still a considerable amount of combustible material inside the house. September, 1989.

a. Piece of Contaminated Furniture from the 107 E. Stratford Residence. Approximately 20 pieces of antique mahogany furniture, such as this classic curved-glass china cabinet, were removed from the 107 residence and successfully decontaminated for the owner.

b. RADCON Technician Locating Spots of Loose Alpha Contamination on a Trunk Locker. After a spot of contamination had been located, it would be washed, rubbed, or scraped off.

c. Chair with Marred Decontamination. All furniture required refi left up to the owner t

cating Spots of Loose Trunk Locker. After a been located, it would ped off.

c. Chair with Marred Finish Following Decontamination. All pieces of decontaminated furniture required refinishing afterwards. This was left up to the owner to do.

d. Decontaminated Chair Wrapped in Plastic and Awaiting Delivery to the Owner. Prior to being returned to the owner, all pieces of decontaminated furniture were individually packaged as shown.

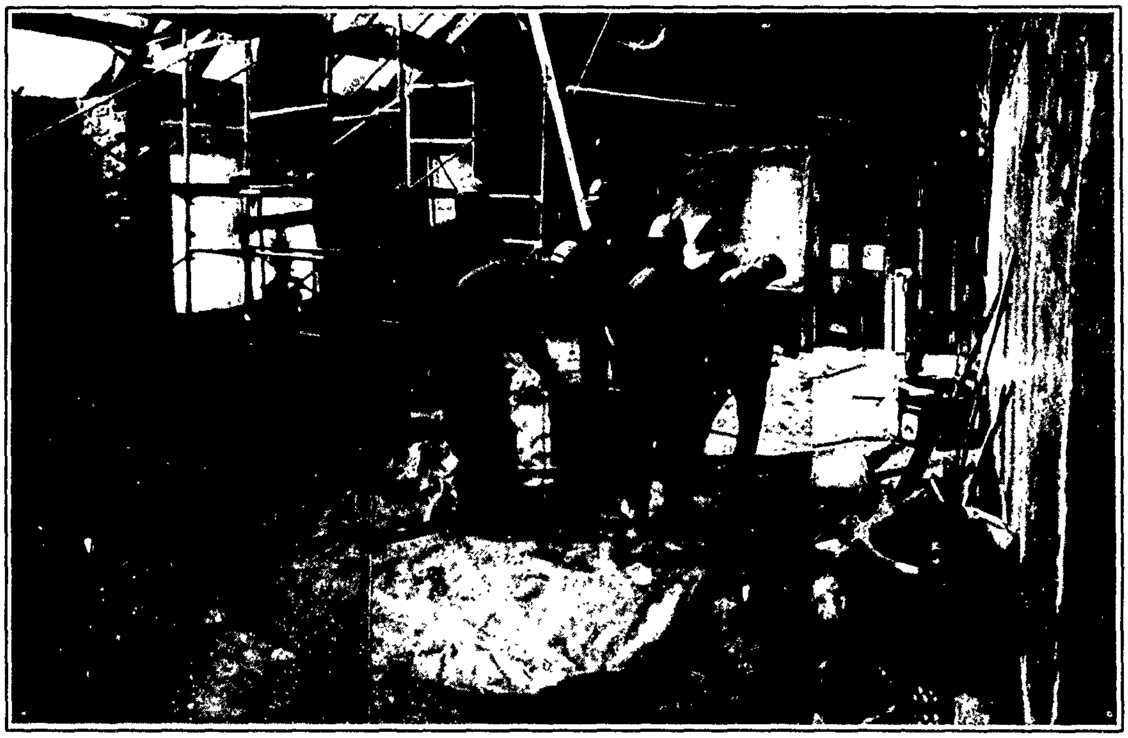
Fig. 6:5 - Furniture Decontamination.
Sept. 1988.

Fig. 6:6 - Contaminated, Antique Porcelain-Sink.
This was one of the few fixtures/furnishings inside the 107 residence that could not be decontaminated. Alpha radiation emitters were deeply imbedded in the porcelain at the location where the alpha probe is shown. After days spent unsuccessfully trying to remove the contamination, the sink finally trashed as rad waste. Sept., 1988.

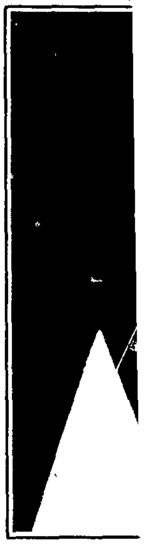
Fig. 6:7 - 68 Shares of AT&T Stock Purchased in 1925 by Mrs. Hanna Groswith.
The Groswith family occuped the 107 side of the duplex at the time Dr. Kabakjian was manufacturing radium products in the 105 side. These stock certificates were certified by site radiation experts to be free of contamination and were returned to Mrs. Groswith's rightful heir. Their value in terms of c.1988 dollars was never learned. Sept., 1988.

a. Workers constructing sealed containment around the exterior part of the main chimney, 105 side.

b. Placing the plastic tarp containment structure over the roof e
105 side.



c. RADCON technicians on the third floor of the 105 side, frisking rubble handed down from the roof.

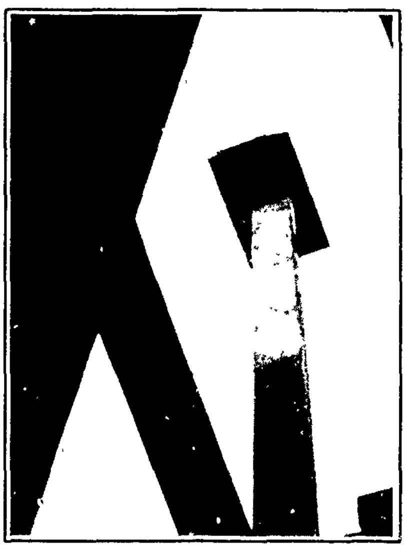


d. Pole used t
the roof exter
space to work

plastic tarp containment structure over the roof exterior,

Fig. 6:8 – Exterior Building Dismantlement.
Exterior building dismantlement began by removing the two chimneys on the 105 side of the duplex. Survey data showed the chimney bricks to have a radiation dose level of around 5 milirem/hour, so the exterior chimney parts were dismantled within a local, HEPA-ventilated, sealed containment. The loose bricks were dropped down the chimney flue and extracted from inside the house. Following removal of the exterior chimney parts, the roof was draped with a plastic tarpaulin. While this may not have been an air-tight containment, the HEPA vaccuum system was able to achieve a condition of negative air-pressure in the work area beneath the tarp. A hole was next cut in the roof from inside the building, and a pole was inserted through the hole to pitch the tarp clear of the roof and provide working space between the tarp and the roof exterior. Workers on the roof exterior would then pass dismantled shingles and roofing boards down to other workers on a scaffold inside the house. Once the rubble was inside the house it was frisked by RADCON technicians to determine if it could be disposed of as clean or radioactive waste. October, 1988.

the roof.



d. Pole used to pitch the tarp clear of the roof exterior to provide workers space to work under the tarp.

Fig. 6-9 – Dismantlement of the 105 Base
Because of the relatively high radiation l
within a sealed containment consisting c
containment was HEPA ventilated with t
Rubble was passed to workers in the pac
and placed into a B-25 box. When a B-25
rest of the basement with plastic curtain
in the basement ceiling. February, 1989.

a. Containment structure over the radium processing room in the rear of the remaining part of the 105 residence. Photo taken facing east.

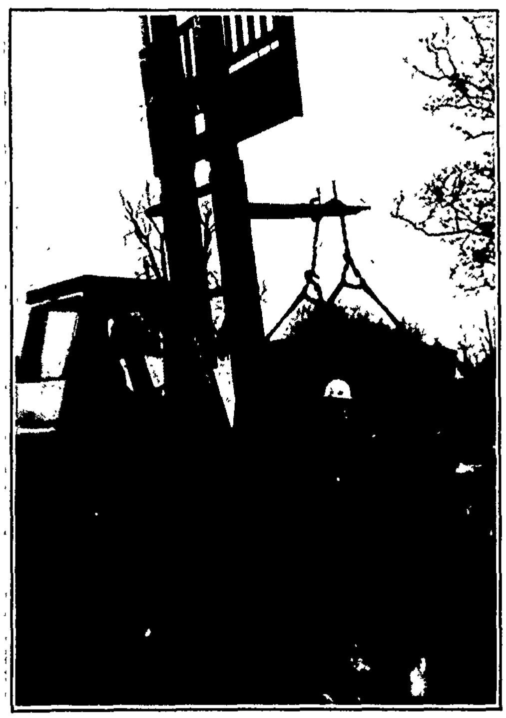
b. Photo taken inside the 105 basement containment, standing in the area of the dismantled radium processing room, facing south toward the packaging containment in the basement center (plastic curtain).

c. Rubble being passed to a worke
box in the packaging room. For di
105 basement, the laborers substit
or powered-air half-face respirators
hat respirators, as these had a hig
safety.

Fig. 6:9 - Dismantlement of the 105 Basement.
Because of the relatively high radiation levels (greater than 100 micro-R/hour) the 105 basement was dismantled within a sealed containment consisting of a double layer of plastic sheeting draped over a light wooden frame. The containment was HEPA ventilated with the 2000 cfm unit. Dismantlement began in the radium processing room. Rubble was passed to workers in the packaging containment located in one of the center rooms of the basement and placed into a B-25 box. When a B-25 box was fully loaded, the packaging containment was sealed off from the rest of the basement with plastic curtains, and the box was vertically hoisted out of the containment through a hole in the basement ceiling. February, 1989.

dismantled radium
nt center (plastic curtain).

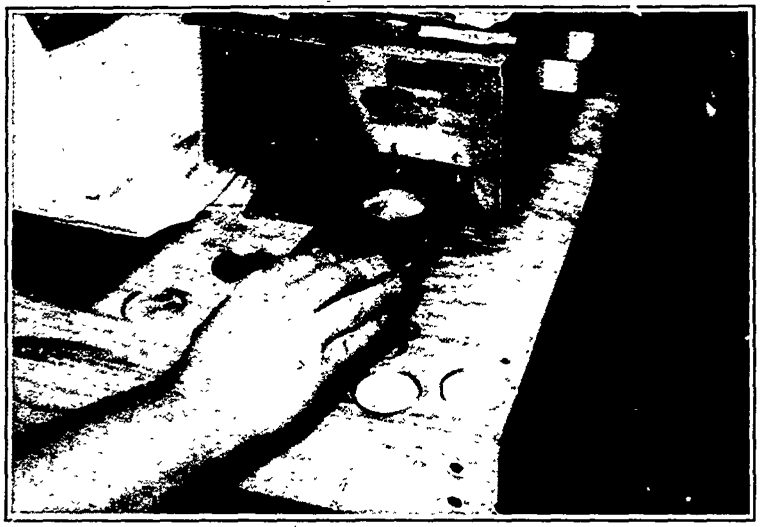
c. Rubble being passed to a worker filling a B-25 box in the packaging room. For dismantling the 105 basement, the laborers substituted full-face or powered-air half-face respirators for their air-hat respirators, as these had a higher factor of safety.



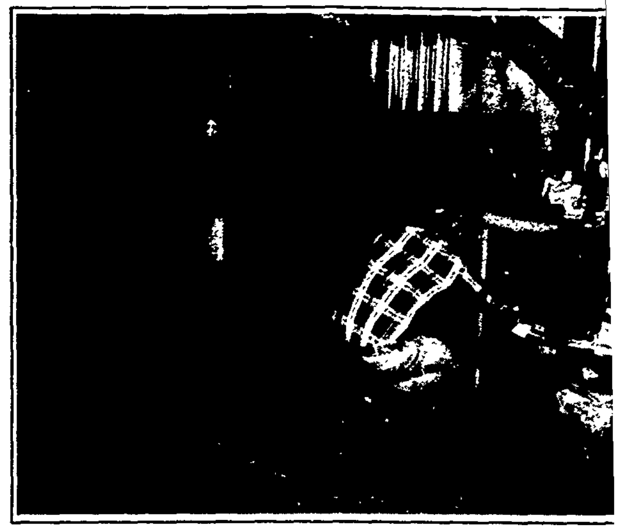
d. Lifting a loaded B-25 box out of the 105 basement packaging containment.

Fig. 6:10 - Brick Rubble Meticulously Packaged Inside a B-25 Radioactive Waste Container.
The unit of payment to the Contractor for radioactive waste disposal was the "ton." However, the cost to the Contractor for radioactive waste disposal was by volume. It was therefore in the Contractor's financial interest to pack as much weight into a 94.3 cubic-foot B-25 box as he could. Pursuant to that end, bricks from the dismantlement of the chimneys and exterior walls of the house had to be laid end-to-end, layer-by-layer, in order for the box to hold the maximum number possible. Taking time to neatly package the bricks did not hold up the progress of dismantlement. It usually took RADCON longer to frisk a load of bricks to conclude that they were all contaminated than it took the laborer inside the packaging containment to neatly pack the load. October, 1988.

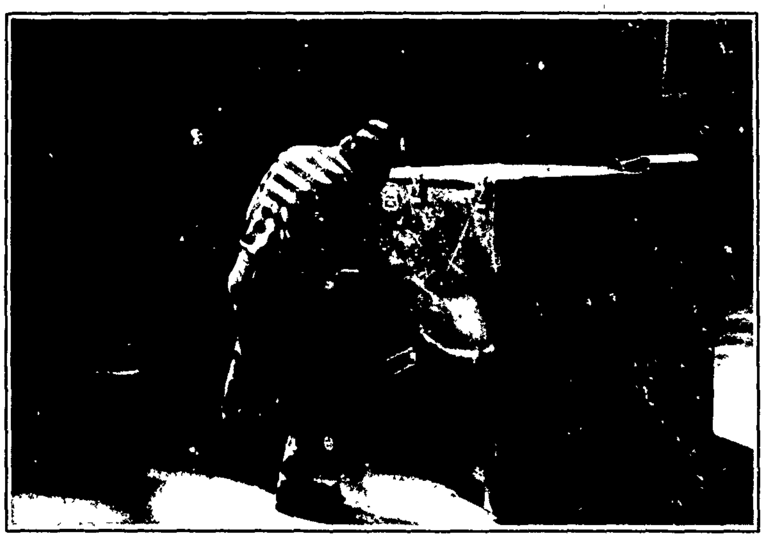
Fig. 6:11 - Steps in Processing Radioactive Waste for Shipment.



a. Filled rad-waste boxes were brought down to the OSF where they were wiped clean and smear samples were taken on all 6 sides to make sure that there was no loose contamination on the outside of the boxes before they were taken out of the radiation exclusion zone. Shown here are smear samples being counted for beta radiation.

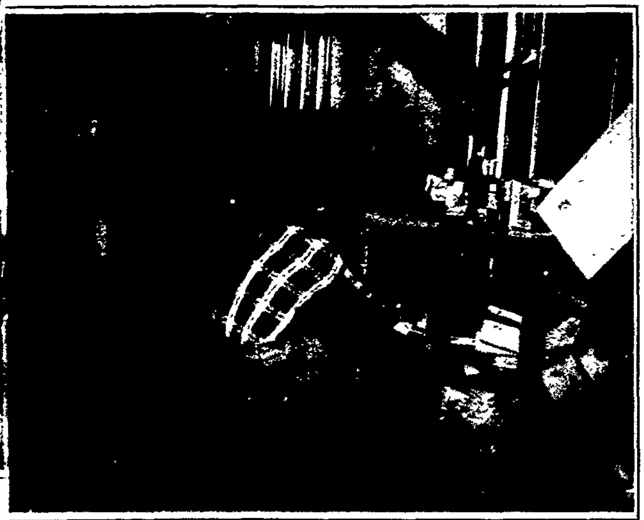


b. After the outside of a box was certified to be free of loose contamination, it was brought into the OSF and weighed on a B-25 box had an identification number to keep track of the net contained within. The Contractor was paid for disposal by the



d. The shipping broker (employed by CNSI) measured the gross activity of each box with a gamma scintillation detector and indicated such on the shipping manifest. The outside of the box in his picture is clean. Any radiation he is detecting is coming from inside the box.

e. Boxes were next affixed with a label reading "Radioactive L Specific Activity), and the boxes were loaded onto a truck for s Loading took place just outside the jobsite security fence on M



outside of a box was certified to be free of loose
on, it was brought into the OSF and weighed on a scale. Every
d an identification number to keep track of the net weight
ithin The Contractor was paid for disposal by the net weight.

c. Boxes awaiting shipment were stacked on E. Stratford Avenue, in the small area between t
security fence. This was the only available non-contaminated area on the jobsite, as the OSF
offices took up all remaining space. The storage area could accommodate up to 20 boxes aw
produced no bottleneck during building dismantlement, as the pace of dismantlement was sl
excavation, the Contractor could pack 20 or more boxes per day. So to prevent the limited sto
slowing down the pace of work, he had to arrange for at least 5 trucks daily to haul the soil a

ıre next affixed with a label reading "Radioactive LSA" (Low
ivity), and the boxes were loaded onto a truck for shipment.
k place just outside the jobsite security fence on Maple Ave.

f. Before departing the jobsite for the disposal area, the loaded truck was given a final check by the ANL health physics support team to make sure that radiation levels were consistent with what the shipping broker had reported on the shipping manifest.

g. With all s
headed out
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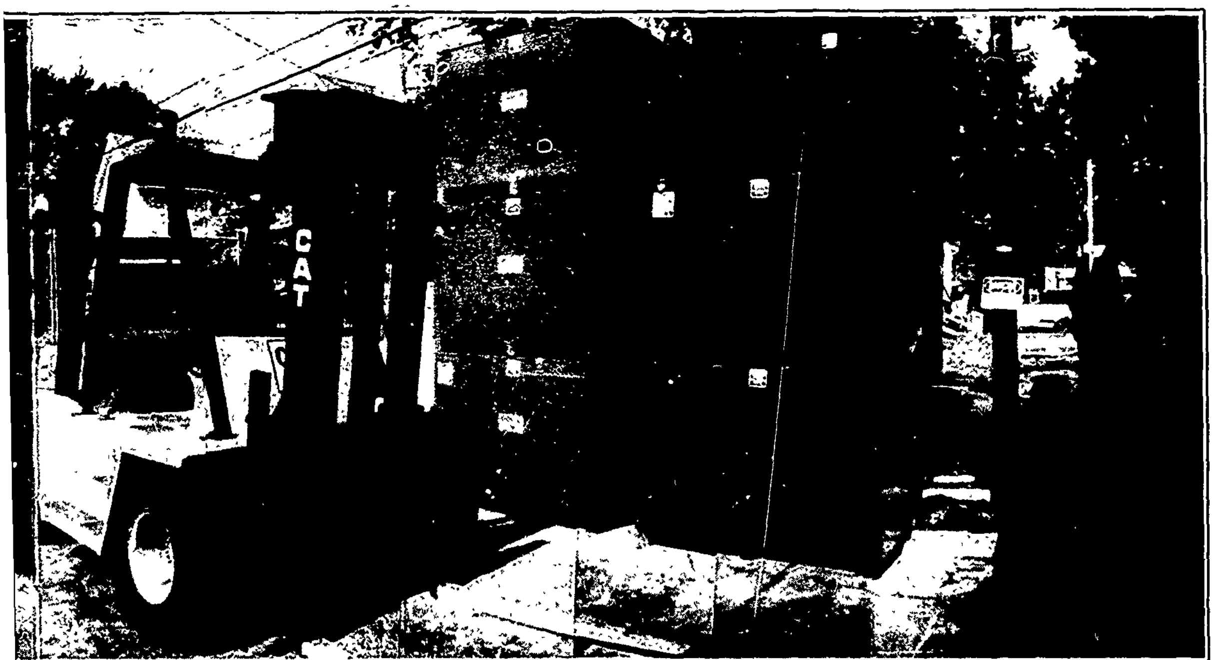
this picture
light-weight
normally ha



d hipment were stacked on E. Stratford Avenue, in the small area between the OSF and the
lm was the only available non-contaminated area on the jobsite, as the OSF and the administration
mremaining space. The storage area could accommodate up to 20 boxes awaiting shipment. That
rineck during building dismantlement, as the pace of dismantlement was slow. But during soil
ftractor could pack 20 or more boxes per day. So to prevent the limited storage space from
ace of work, he had to arrange for at least 5 trucks daily to haul the soil away.

Cue jobsite for the disposal area, the loaded truck was
wry the ANL health physics support team to make sure
cwere consistent with what the shipping broker had
cing manifest.
n
c

g. With all shipping documents in order, the placarded rad-waste shipment headed out of Lansdowne bound for Utah. 40,000 lbs gross was the maximum weight a truck was permitted to haul. The fact that the truck in this picture has a load of 12 boxes indicates that the boxes contained light-weight rubble from the house. Trucks hauling radioactive soil normally had a load of only 4 boxes weighing around 10,000 lbs. each.

CHAPTER 7

SOIL EXCAVATION

69/70

7.0

SOIL EXCAVATION

7.1 Magnitude

Contaminated soil was found over an area of approximately 40,000 square feet, and encompassed all or portions of the following properties: 99, 105-107, and 115 E. Stratford Ave.; 60 N. Union Ave.; 110, 112, and 114 East Stewart Ave; municipal property underneath the sidewalks and street of Stratford Avenue, and between the sidewalk and curb, in front of the 105-107 and 110 E. Stratford Ave. residences. Depth of contamination ranged from 1 to 11 feet. In all, 4109 tons (83,266 cu. ft.) of waste was disposed of as contaminated soil. Of that figure, approximately 150 tons was in reality clean rubble in the form of asphalt pavement from the sewer excavation on E. Stratford Ave., and wood and stucco from the Gretzenberg garage at 112 E. Stewart Ave. At the time, it was simply more practical and economical for the Government to dispose of this clean rubble along with the radioactive soil than to send it to a sanitary landfill. The Envirocare disposal site in Utah offered no objections to this practice. The contaminated soil was shipped to Envirocare in 878 metal, B-25 boxes, having a capacity of 90 cubic feet. It took 212 tractor trailers to haul the soil away (Fig. 7:1).

7.2 Schedule of Excavation

Soil excavation was undertaken in 3 separate phases:

(1) Excavation of a 20' x 60' test plot in the backyard of the 105- 107 E. Stratford Ave. property, hereafter referred to as the First Argonne Subsurface Investigation.

(2) Excavation of contaminated soil around the basement walls of the 105-107 E. Stratford residence before the basement walls were dismantled.

(3) Excavation of soil on adjacent properties and other areas of the 105-107 E. Stratford Ave. lot.

7.2.1 First Argonne Subsurface Investigation

This first phase of soil excavation was accomplished during the period 5-10 December, 1988, after the house had been dismantled down to the floor boards on the first floor. The work was the concluding part of an experiment undertaken to develop a technique for locating radioactive contamination in the subsurface and estimating excavation quantities. About a month earlier, while the Contractor was at work dismantling the exterior walls of the house, Argonne

National Laboratory had made soil-tube gamma radiation measurements through electrical conduit, driven to a depth of 10 feet into the soil, on an approximate 10' x 10' grid, over a 20' x 60' area in the backyard north of the house. Based on these measurements, Argonne estimated the configuration of the excavation subgrade and the quantity of soil that would have to be removed. This information was not revealed to the Contractor until after he had finished excavating the test plot. The idea was to make a subjective judgement after excavation was over, on whether the Contractor could have done the job faster had he known in advance where and how deep he would ultimately have to dig. It was thought at the time that the Contractor's method of surveying the soil for radioactivity, as it was being excavated from the test plot in shallow lifts, would be a time-consuming process. As described below, that did not turn out to be the case.

7.2.1.1 Results of the Argonne Experiment

Argonne's estimate of contaminated soil in the test plot was 402 tons. The Contractor ended up taking out 417 tons, which made the Argonne estimate reasonably accurate. The floor of the excavated test plot also correlated well with the configuration Argonne had predicted. As a method for estimating quantities, Argonne's experiment was a success. It would later provide a means of predicting the total quantity of contaminated soil that would ultimately be excavated over the jobsite, when the estimated contract quantity of 1000 tons was exceeded. This was especially helpful in estimating the additional funds required to perform the additional 3,097 tons of soil excavation. As a means of expediting the work of soil excavation, Argonne's experiment had no impact. It was discovered during excavation of the test plot that a maximum of 5 truck-loads of radioactive waste per day were all that could be shipped off the site, owing to the logistical constraint of storage space for B-25 boxes filled with contaminated soil and frequent scheduling problems with the trucking company. It happened that the size of the Contractor's labor force was adequate to excavate enough soil, using the iterative scanning and scooping method, to make 5 truck-loads/day.

7.2.2 Soil Excavation Around Basement Walls.

This was accomplished during the period of 7 Dec. 1988 - 10 Jan. 1989, as a prelude to basement dismantlement. Approximately 4 feet of contaminated soil around the perimeter of the house was removed, not only immediately adjacent to the basement walls, but also in the adjacent yard areas. The idea was to enable the basement to be dismantled without creating a steep excavation in the surrounding soil which would either have to be shored, or laid back, which would then have made it difficult for the Contractor's vehicles to access different parts of the site. When this phase of soil excavation was complete, the yard areas around the remainder of the house were still essentially flat, though about 4-feet lower in elevation. The soil was also still contaminated in most places, but final clean-up would have to wait until after the basements were removed. When the basement walls and foundation subsequently were

removed, a 3-foot deep pit was all that was created.

7.2.2.1 Consequence of Soil Excavation Around Basement Walls.

The noteworthy consequence of this phase is that in only 20 working days, 1000 tons of contaminated soil were removed. When that figure was added to the 417 tons excavated from the test plot, it exceeded the original 1000-ton contract estimate for contaminated soil. Furthermore, there were still many areas on the site that had not yet been touched, but where above background radioactivity was noted to be emanating from below the surface. In the early part of December, 1988, it was possible to predict that if the Contractor maintained his rate of soil excavation, total contract funds would be exhausted before the end of the year. The Corps of Engineers, therefore, had to request additional funds from the EPA to pay for the overrun but could not estimate the amount because it did not know how much contaminated soil remained on site. With EPA concurrence, the Corps therefore tasked Argonne National Laboratory to undertake a second subsurface investigation, similar to the one they had performed in the test plot. This time, however, Argonne would survey the entire 105-107 E. Stratford Ave. property and all immediately adjacent properties that had not already been excavated.

7.2.2.1.1 Second Argonne Subsurface Investigation (Fig. 7:2).

During the week of 12 December, 1988, Argonne National Laboratory mobilized 9 additional health physicists and technicians onsite to undertake a comprehensive subsurface investigation. Over 300 lengths of electrical conduit were driven into the ground on the same grid pattern previously used in the test plot. Based on soil-tube gamma measurements made via the conduit, Argonne concluded that the overrun quantity of contaminated soil would amount to 3200 tons. Ultimately, 2947 additional tons was actually excavated. Argonne's estimate was sufficient to enable the Corps of Engineers to justify a request for additional funds from the EPA to pay for the soil overrun. Their technique of investigation may ultimately find wide usage in the nuclear industry.

7.2.3 Soil Excavation on Adjacent Properties and Other Areas of the 105-107 E. Stratford Ave. Lot.

This phase of soil excavation was undertaken during the period 28 Feb. - 24 April, 1989, following dismantlement of the basements. It accounted for 2530 tons. Excavation started at the north end of the jobsite, where Argonne had discovered contamination on adjacent E. Stewart Ave. and Union Ave. properties bordering the 105-107 E. Stratford lot, and worked progressively south to E. Stratford Ave. By the time it was completed, two garages and several large trees on adjacent properties had been removed, and the jobsite had the appearance of a trenched and cratered battlefield (Figs. 7:3 and 7:4).

However, the vast amount of soil removed and the appearance of the site after its removal was anticipated from the findings of Argonne's second subsurface investigation.

7.2.3.1 Ash Pits and Garbage Dumps.

The Plan of Excavation (APPENDIX H, page H-2) shows a patchwork of circular depressions ranging in depth from 3 - 12 feet. These depressions represent the principal burial sites where radioactive debris was unearthed. The largest three of these disposal areas, designated as Sites A, B, and C on the Excavation Plan, are located on properties adjacent to 105 E. Stratford Ave. Site A, from which approximately 180 tons of contaminated ashes, bottles, laboratory apparatus, and miscellaneous garbage were excavated, straddled the properties of Georgianna Gretzenberg and John Townsende at 110 and 112 E. Stewart Ave., about seven feet north of the property line with 105 E. Stratford Ave. Excavating Site A uncovered some stone ruins which were the subject of an archaeological investigation by the Baltimore District (See Appendix B and Fig. 7:5). Site B, which yielded about 90 tons of similar materials, lies exclusively within the Townsende property, 23 feet north of the 105 E. Stratford property line. Site C, which yielded about 250 tons of contaminated soil, ashes, etc., lies on the 107 E. Stratford property, about 30 feet east of the property line with the 105 side. The most contaminated materials handled over the course of the job came out of these ash pits. The gamma emissions produced by some of the test tubes and pipettes measured 500,000 cpm on a Eberline PRM-5-3 and 4 milli-Roentgens/hour on a PRM-7.

7.2.3.2 Contaminated Soil Around Sewer Laterals.

The dog-leg trenches on the Topographical Plan of Excavation, designated as Areas D and E on the Topographical Plan of Excavation (Appendix H), represent the locations of the lateral sewer pipes, which ran from the house to the main sewer line on E. Stratford Ave. They accounted for several hundred tons of contaminated soil, most of which came from around the 105 lateral. When the 105 lateral was unearthed, it was found that most of the 3-foot lengths of bell and spigot sewer pipe were not connected. The dog-leg bend in the lateral had been accomplished by not fully seating the bell/spigot joint. Furthermore, some small sections of line even ran slightly uphill. These factors probably allowed large amounts of exfiltration, which produced the residual contamination found in the surrounding soil.

7.3. Contamination Criteria for Soil.

The only radiation clean-up standards for soils were established under the Uranium Mill Tailings Radiation Control Act ("UMTRCA"), P.L. 95-604, by EPA regulations found at 40 CFR Part 192 et.seq. The regulations established a

radiation level of 5 pCi/g (above natural background) for the top 15 cm of soil and a level of 15 pCi/g for soils below 15 cm. The 5 pCi/g level was established assuming that any direct contact with contaminated mill tailings would be with the top layer of soil. The law also assumes no disturbace of the lower soil layers.

No soil clean-up levels were set by the EPA's Record of Decision. During the development of the RFP, and as a result of extensive discussions among Corps of Engineers, EPA and Argonne National Laboratory personnel, it was decided that the 5 pCi/g level was protective of human health and was the only criterion that was defensible. The 5 pCi/g (above natural background) level was used for all soil depths at the Lansdowne Radiation Site because of the high probability of future soil disturbances. The area in which the site is located is essentially urban and is subjected to building construction and underground utility repair and replacement.

The 5 pci/g release criteria for soil at Lansdowne pertained to the combined activity of the radionuclides Ra-226, Th-230, Ac-227 and Pa-231. It had been determined from the Argonne Radiological Assessment of 1984 that there was no uranium contamination at the Lansdowne site. The absence of uranium, other than from natural background, meant that Kabakjian probably worked with radium that had been refined to some extent from uranium ore. The source (or sources) of the ore from which the radium had been extracted was unknown, but there were several possible locations, some of which would have contributed Th-230, Ac-227 and Pa-231 to the partially refined radium that Kabakjian further purified in the basement of his house.

7.4 Quality Control Procedures.

Quality control pertained to the techniques used by the Contractor to see that soil was correctly classified as contaminated or clean, and its disposition was made according to applicable contract provisions.

7.4.1 Field Determination of Contaminated/Non-Contaminated Soil.

Contaminated soil removal was performed by a subcontractor, Carlucci Construction Company, of Cheswick Pennsylvania, using a John Deere, Model JD-410, backhoe and a Poclain trackhoe. Radiation Control Technicians (RADCON) provided by another subcontractor, Hilbert & Associates, directed Carlucci's equipment operators. RADCON surveyed the areas with a Ludlum Model 2220 portable scalar/ratemeter, equiped with a shielded sodium-iodide crystal detector, and marked off areas of contaminated soil with a can of spray paint. Contamination criteria was anything over 2500 cpm., counted with the Ludlum. Before soil excavation began, a correlation curve was established between cpm detected with the Ludlums and the activity of radium present in the soil in pCi/g, as determined by gamma spectroscopy. Soil that produced over 2500 counts per minute (gamma) on the Ludlum was considered to have more than 5

pCi/g of radium above local background and was marked off with spray paint for Carlucci to excavate.

7.4.2 Deficiencies in Field Determination Techniques.

The gamma emissions counted by the Ludlum came from other radionuclides in the soil besides radium. The soil on the site contained occasional high concentrations of the naturally occurring radionuclide Potassium-40 (K-40). This was discovered during spectroscopic analysis of soil samples to verify that release criteria had been met. Some of these samples produced slightly under 2500 cpm, so they were assumed to have slightly under 5 pCi/g of radium above background. Gamma spectroscopy showed them to have only background levels of radium (i.e., 1.5 pCi/g). Most of the activity which accounted for the nearly 2500 cpm on the Ludlum was attributable to K-40. Exactly how much additional soil was excavated because it had slightly over 2500 cpm as a result of its K-40 content is not known, but it is not felt to be a significant amount.

7.5 Quality Assurance Procedures.

Quality Assurance pertained to the oversight of job safety and verification that the Contractor was achieving the desired result of the remediation effort, and achieving it in a manner that was not deleterious to the interests of the Government. Q/A was the responsibility of the Corps of Engineers and the Corps' technical consultants on radiological matters from Argonne National Laboratory.

7.5.1 Verification Sampling and Testing (Fig. 7:6).

After RADCON had concluded a patch of ground to have been cleaned up based on the 2500 cpm criteria, a sample of the reportedly clean soil was collected for every 10' x 10' area and split between the Contractor and the Government. The split sample was subjected to gamma spectroscopy to quantify the activity of radium contained therein in terms of pCi/g. In most cases, gamma spectroscopy confirmed the conclusions of field RADCON. In those cases where it did not, the excavation was deepened and additional verification samples were taken from the floor and analyzed until they showed the excavation floor to have been cleaned up. Ten percent of verification samples were split between the Government and the Contractor and analyzed by radiochemical analysis at offsite laboratories of each. This was required to identify and quantify the radionuclides Th-230, Ac-227 and Pa-231, which could not be analyzed on the jobsite by gamma spectroscopy. By radiochemical analysis, only background amounts were found. Extensive treatment of procedures employed and results achieved in verification sampling and testing is provided in the

radiological close-out reports of Chem-Nuclear Systems, Inc. (Volumes 2 & 3) and Argonne National Laboratory (Volume 4).

7.5.2 Safety.

The principal safety concerns during soil excavation were:

(1) slope failures in the sidewalls of the excavation.

(2) radiation exposure to personnel involved with excavation operations.

(3) contamination of the atmosphere by the generation of airborne radioactive soil particles.

(4) cross-contamination of clean areas by runoff from contaminated areas, or by personnel tracking contamination out of the radiation-controlled zone.

7.5.2.1 Slope Stability.

The sidewalls of the excavation were stabilized in accordance with the provisions of the Corps of Engineers Safety Manual.[11] That is, where the excavation went to the 5-foot depth or greater, the sidewalls were sloped on a maximum gradient of 3/4 horizontal to 1 vertical. In cases where clean soil had to be removed to attain such a slope gradient, the soil was stockpiled for later use as backfill. Also, vehicular traffic was kept at least three feet away from the upper edge of a slope. There were no slope failures nor any accidents resulting from unstable slopes during soil excavation.

7.5.2.2 Radiation Protection.

Personnel working in the radiation-controlled zone wore hard hats, cotton coveralls, rubber boots or plastic boot covers, and thin latex gloves under cotton gloves or leather-palmed gloves. This apparel was usually adequate to keep contaminated soil off their underclothing and skin. Protective clothing and equipment was decontaminated by RADCON at the conclusion of each day's work, by either laundering, wiping or scrubbing it clean. If it could not be decontaminated in this fashion, it was trashed as rad-waste. Personnel working in the exclusion zone always donned clean protective clothing and equipment at the start of the working day. Full-face respirators were worn during soil excavation up until 7 Dec. 1988. On that date, the Government approved a Contractor request for a downgrade to no respiratory protection, upon the recommendation of the onsite health physicist from Argonne National

Laboratory. This decision was based on exhaustive lapel (i.e., breathing zone) air-sampling data, collected over a period of several weeks, which showed that the dampness of the freshly excavated soil kept it from becoming airborne in concentrations that exceeded the MPC. However, those personnel working within 6 feet of a B-25 box, as it was being loaded with soil, were still required to wear protective glasses and paper masks to prevent receiving facial splatters of contaminated soil to the eyes, mouth and nose, as the soil inside the box was being compacted with a tamper. Monthly urinalysis on all jobsite personnel showed that no one received an internal radiation dose during the period of soil excavation. The laboratory data supporting this finding is contained in the close-out report of Chem-Nuclear Systems, Inc. (Volume 3).

7.5.2.3 Air Monitoring.

Continuous Air-Monitoring Stations (CAMS) located on all four sides of the jobsite indicate that there were no releases of radioactivity into the environment. However, it was occasionally observed that momentary clouds of dust would get kicked up on especially windy days. These were generated from the concrete driveway and slab on the 105-side, some distance away from the CAMS, and appear to have been contained within the work area. Contaminated soil would get tracked onto the concrete by the Contractor's vehicles and would quickly dry out. Such soil had to be continually wetted down with a garden hose to keep it from becoming airborne.

7.5.2.4 Cross Contamination.

Where the topography was such that an area of cleaned-up ground could receive runoff from an area of contaminated ground, both would be covered with a flexible plastic sheet when no work activities were in progress. The plastic sheet would be removed from the contaminated ground only when remediation activities were underway. In cases where an area of cleaned-up ground could receive no runoff from contaminated ground, the area was roped off, and no personnel were permitted to trespass until after soil remediation was completed. This system worked well, as evidenced by the fact that none of the cleaned-up areas subsequently became re-contaminated.

Preventing workers from tracking radioactivity out of the radiation-controlled zone was not completely successful. From time-to-time during soil excavation, weekly swipe-sample surveys on the floors of the trailers in the jobsite administration area showed above background levels of loose contamination, necessitating frequent mopping of floors. The highest findings always coincided with a period when the radiation-controlled zone was especially sloppy from rain or melted snow. At such times, it was difficult to keep the floor of the frisking station (where personnel exited the controlled zone) clean of mud. In the process of frisking themselves out of the controlled zone, this mud would sometimes get transferred to the soles of the worker's boots, after they had removed their outer protective boots or plastic boot covers. Some of the swipe surveys turned up loose alpha particles. On one

occasion, 148 dpm of alpha was counted on a swipe sample taken over a 100 sq. cm. area on the floor of the crew trailer, where the workers took their lunch and coffee breaks. Lesser amounts of contamination were detected in the OSF, the Contractor's office trailer, and in the Government's office trailer. Workers had to be continually reminded to frisk themselves carefully when exiting the radiation controlled zone.

7.6 Overall Evaluation of Soil Excavation.

Despite the problems which were encountered regarding the initial estimation of excavation quantities, and despite the various other problems and discoveries noted above, the process of contaminated soil excavation went remarkably well. Furthermore, it proceeded in an efficient, deliberate fashion, even in those areas where structures or other features had to be removed, and even throughout all the winter months of 1988/1989.

a. RADCON technicians marked off areas of contaminated ground with red spray-paint to direct the Poclain operator where to dig.

b. A Poclain MD-80 tracked hoe was used for the bulk of soil excavation. The hoe could swing 180° and drop the load in its bucket directly into a B-25 box.

c. Pla
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d. About 20% more density could be obtained by compacting soil filling a B-25 box in 12-inch lifts. This was especially important to the Contractor because payment by the Government for disposal was by weight and his costs to the disposal facility were by volume.

e. Several large trees on adjacent properties were enveloped by the expanding area of the soil excavation and had to be removed. Such trees were replaced for the owners during site restoration, however with nursery stock.

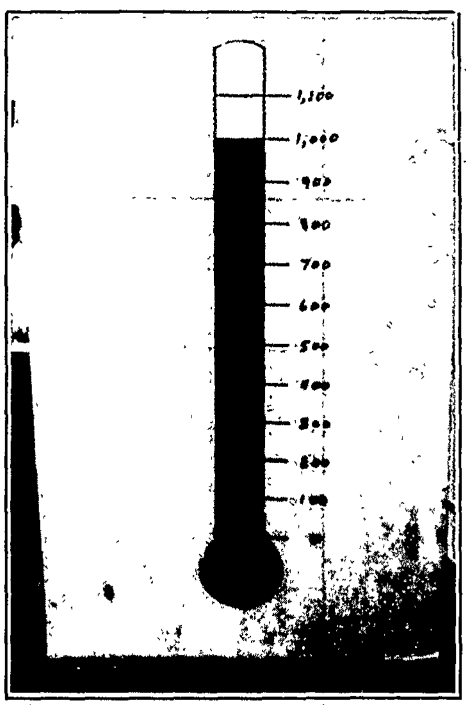
f. Stumps of trees that had been growing
contaminated soil did not always come o
easily. This walnut stump with a large tra
took the better part of a day to remove. S
were packed with soil in the B-25 boxes a
disposed of under the contract pay item f
contaminated soil removal.

ed for the bulk of soil
and drop the load in its

c. Plastic sheeting was used to prevent runoff from contaminated ground from cross-contaminating ground that had been cleaned up, such as that on which the workers are standing at the bottom of the excavation.

Fig. 7:1 – Scenes from the Progress of Soil Excavation.

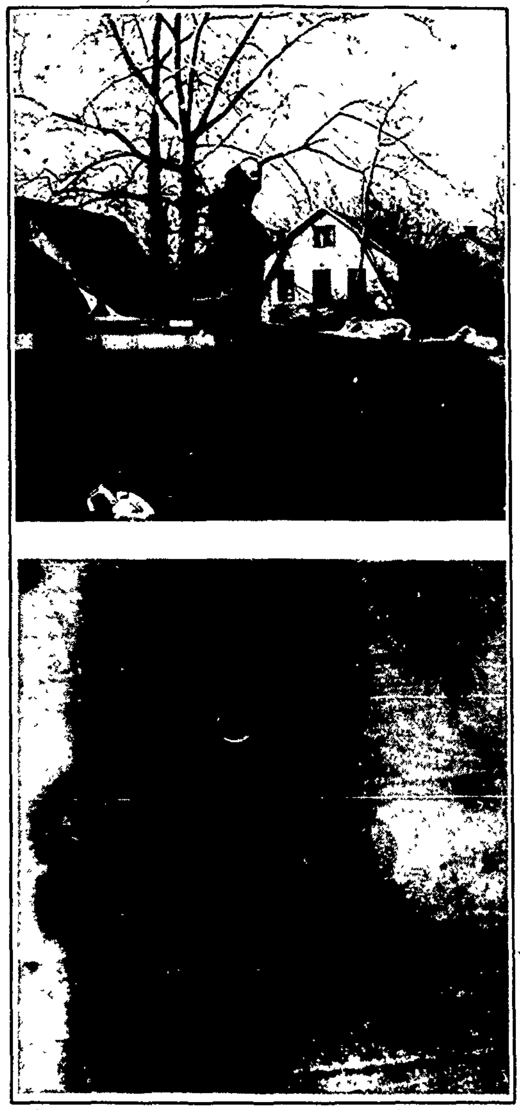
umps of trees that had been growing in aminated soil did not always come out y. This walnut stump with a large trap root the better part of a day to remove. Stumps packed with soil in the B-25 boxes and osed of under the contract pay item for aminated soil removal.



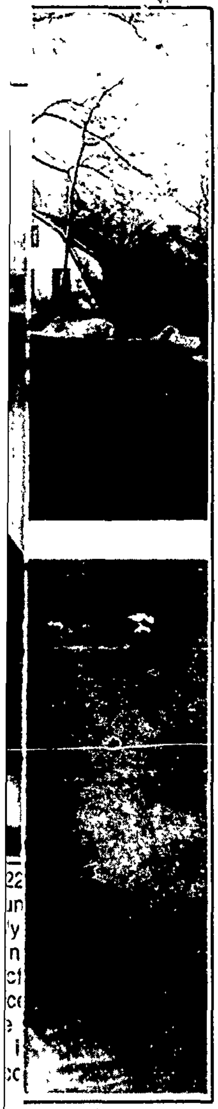
g. On 31 Nov 88, the Contractor posted this chart in the crew trailer to gage the rate of soil excavation. He told his workers that if the tons of soil excavated reached the green line by 22 Dec. they would not have to return from Christmas break until 2 Jan 89. The line was reached on 11 Dec. By 22 Dec., the excavated tonnage was off the chart.

h. After all contaminated soil had been removed, the surface area was surveyed to prepare a topographic map of the excavation grade.

a. Workers driving aluminum conduit tubes in the jobsite administration area. The OSF is in the background; crew trailer is at right. A "Cobra" gasoline powered hammer, manufactured by Atlas-Copco was used to drive the pipe. A steel penetrometer point on the penetrating end of the pipe facilitated penetration and kept soil out of the inside of the pipe. The pipe in this photograph is being driven through the pavement of E. Stratford Avenue, in the vicinity of the sewer lateral from the 105 residence. Subsequent subsurface logging indicated that there had apparently been considerable exfiltration of radioactive contamination from the lateral. This was confirmed when the area was excavated.



b. Workers driving conduit through the first floor of the 105/107 residence. No part of the site escaped investigation. Where structures stood in the way, the pipe was driven through holes made in the structures. This went for concrete floor slabs, streets, side-walks, private driveways, etc.



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c. Ludlum 2220 scalar/ratemeter being used to make a count of subsurface radioactivity. Counts were usually made for a period of 1/10 of a minute. Using the sodium iodide detector, a count rate of 800 cts/min corresponded to a Ra-226 concentration in excess of clean-up criteria. The count rate of 380 cts/min shown on the Ludlum in this photograph indicates that the soil is not contaminated.

d. Health physicist from Argonne lowering the sodium-iodide detector through one of the pipes driven into the ground. The cable is marked off in 1/2-foot increments and runs to the Ludlum 2220 scalar/ratemeter being operated by a second health physicist who recorded the radiation counts. The stick-up on the pipe in the background indicates that it hit something solid in the subsurface and could not be driven its full length of 10 feet. This was a frequent happening, as the soil contained numerous boulders. It did not, however, detract from the accuracy of the survey.

Fig. 7:2 - Second Argonr
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was exceeded during the
became necessary to ob
To that end, Argonne Na
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alth physicist from Argonne lowering the m-iodide detector through one of the pipes i into the ground. The cable is marked off -foot increments and runs to the Ludlum scalar/ratemeter being operated by a id health physicist who recorded the ion counts. The stick-up on the pipe in the ground indicates that it hit something solid subsurface and could not be driven its full n of 10 feet. This was a frequent happening, soil contained numerous boulders. It did owever, detract from the accuracy of the y.

Fig. 7:2 - Second Argonne Subsurface Investigation.
When the initial contract estimate of 1000 tons of contaminated soil was exceeded during the first several days of soil excavation, it became necessary to obtain additional funds to pay for the overrun. To that end, Argonne National Laboratory was tasked to do a comprehensive radiological survey to determine the amount of contaminated soil and hence the amount of additional money that would be required to pay for its removal.

Over 300 aluminum conduit tubes were driven into the ground on a 10′ x 10′ grid. These tubes were 10-feet in length and had an inside diameter of one inch. Additional tubes were sometimes driven to split the 10-foot grid in places where the Argonne team wanted more detailed information. Following initial establishment of the grid of tubes, a 3/8-inch diameter sodium iodide detector was lowered down the inside of the tubes and disintegrations were counted at 1/2-foot increments with a Ludlum 2220 scalar/ratemeter. Prior to this subsurface logging of the holes, soil samples were obtained from various locations on the site and analyzed by gamma spectroscopy to obtain an approximate correlation between the subsurface logging data obtained by the Ludlum and the release criteria of 5 pCi/g of Ra-226 above local background.

By this technique, Argonne was able to predict the subsurface contamination profile and estimate remaining quantities, which turned out to be short by only about 100 tons. Considering that around 4100 tons of contaminated soil were excavated, that is a highly accurate estimate. December, 1988.

Fig. 7:4 - Jobsite Facing South from the 112 E. Stewart Property Near the End of the Final Phase of Soil Excavation. The photo mosaic is taken from the same perspective as Fig. 7 above. The two garages and tl.e 105 basement are gone, along with approximately 4100 tons of contaminated soil. The irregular excavation grade reflects how the radioactive contamination was distributed in the subsurface. March, 1989.

Fig. 7:3 - Jobsite Facing South from the 112 E. Stewar the Final Phase of Soil Excavation.
The soon to be dismantled 112 E. Stewart garage is in foreground, and the contaminated 107 E. Stratford gar: foreground behind the tree. The containment structure foreground covers the 105 E Stratford basement wher underway. February, 1989.

inal Phase of Soil Excavation.
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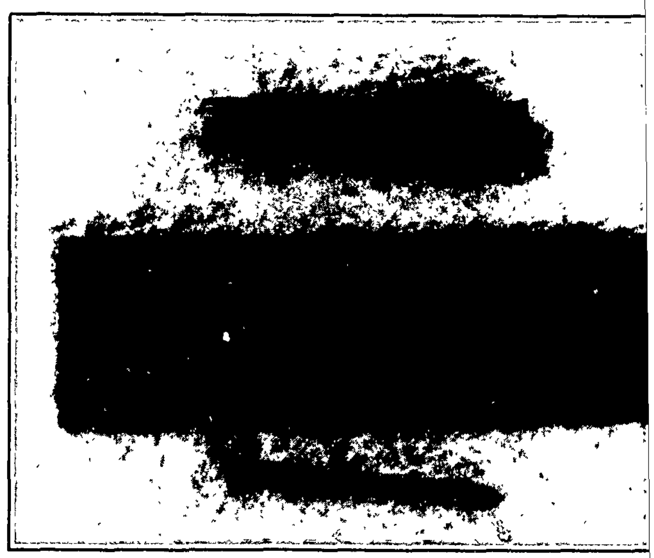
Fig. 7:3 - Jobsite Facing South from the 112 E. Stewart Property Prior to the Final Phase of Soil Excavation.
The soon to be dismantled 112 E. Stewart garage is in the right foreground, and the contaminated 107 E. Stratford garage is in the left foreground behind the tree. The containment structure in the center foreground covers the 105 E. Stratford basement where dismantlement is underway. February, 1989.

a. Garage at 110 E. Stewart Ave., underneath which lay the 17th Century root cellar used as a burial site for radioactive waste. The structure is shown being demolished by a Poclain MD-80 track excavator as a prelude to excavating contaminated materials underlying it.

b. Ruins of the 17th Century root cellar after removal of the radic garbage that had filled its 11-foot high walls to the top.

c. Some of the antique bottles recovered from the root cellar. All of the bottles were contaminated and had to be disposed of as radioactive waste.

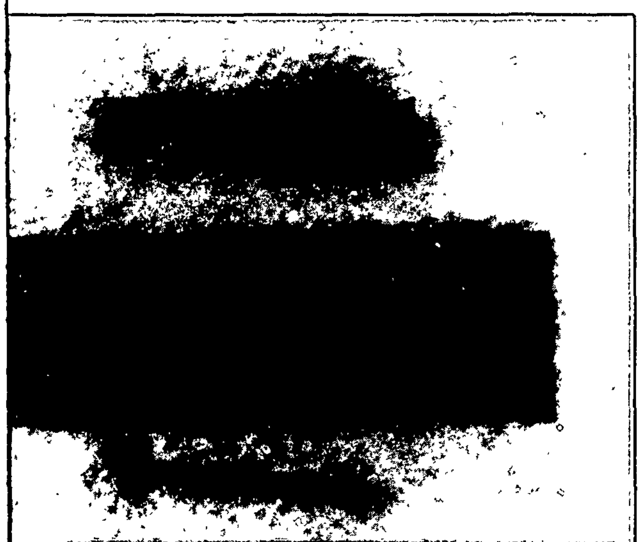


d. Test tube (above) and pipette or needle (below), which were bur other radioactive garbage. These were the two most contaminate ever handled in the course of site remediation. They were so "hot their cpm exceeded the capacity of the Ludlum 2220 scalar-ratem used by ANL to detect radioactivity.

the 17th Century root cellar after removal of the radioactive
at had filled its 11-foot high walls to the top.

Fig. 7:5 - Archaeological Find.
One of the biggest surprises of the remediation effort was the discovery of an old stone foundation or root cellar beneath the garage at 110 E. Stewart Avenue. The overlying garage was not contaminated, but it had to be removed in order to access contaminated soil that was known to underlie it from the findings of the Second Agonne Subsurface Investigation. In the process of excavating that soil, the root cellar was exposed.

The existence of the root cellar was unknown even to lifelong residents of the neighborhood. It was filled to the brim with radioactive garbage in the form of ashes, broken laboratory apparatus, and early 20th Century glass bottles. The 11-foot deep cellar was ascribed by the Baltimore District archaeologist to the 17th Century Swedish settlement on nearby Darby Creek. March, 1989.



(above) and pipette or needle (below), which were buried with
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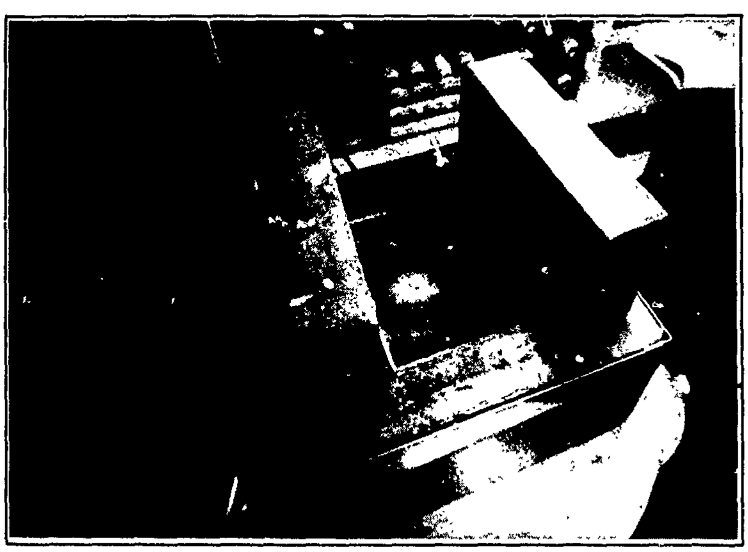
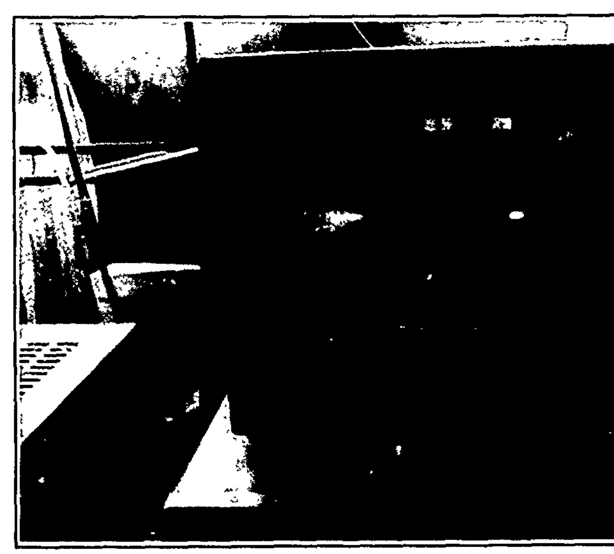
L to detect radioactivity.

a. Health physics technician from Argonne National Lab preparing a Marinelli beaker inside the Government's mobile field laboratory located on the jobsite.

b. Partially field Marinelli beaker showing the hollow cylinder o which fitted around the gamma detector to practically surroun tor with the soil sample being analyzed.



c. Marinelli breaker on the gamma detector prior to counting. The lead bricks, shown standing on end, were laid flat to close off the opening and prevent extraneous cosmic radiation from reaching the detector and distorting the count.



d. Gamma spectrography of the radionuclides in a verification s undergoing analysis. The gamma peak for radium lies just unde dot, in the 186 KeV range. Other peaks shown represent differe occurring radionuclide in the soil of different energies, includin daughter products. The greater the concentration of a radionuc soil, the more disintegrations per unit of time that would be pro the higher the peak would climb on the screen. From the heigh peak on the gamma spectrograph, health physicists were able t the pico-Curies responsible for producing it, and by measuring of soil in the Marinelli beaker, they were able to calculate pico- gram.

lly field Marinelli beaker showing the hollow cylinder on the inside
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the soil sample being analyzed.

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r the peak would climb on the screen. From the height of the
he gamma spectrograph, health physicists were able to calculate
Curies responsible for producing it; and by measuring the weight
the Marinelli beaker, they were able to calculate pico-Curies per

Fig. 7:6 - Verification Testing of Soil Samples
After field RADCON had concluded most of the ground to be cleaned up to 5 or less pCi/g of radium above background, verification samples of the soil were collected and subjected to gamma spectroscopy to confirm that release criteria had indeed been obtained. Such analyses were performed by both the Contractor and ANL, at field laboratories located on the jobsite. In addition, verification samples were also sent off site to independent laboratories for testing.

The procedure employed by ANL was to pack the verification sample into a Marinelli beaker. The configuration of the Marinelli beaker allowed the sample to virtually surround the detector, permitting the maximum radium disintegrations to be counted. It was the limitation of field RADCON's instruments that they also picked up a lot of extraneous radiation from sources other than radium. That made quantification of radium activity in the soil by field RADCON inconclusive and necessitated the more accurate spectroscopic analysis for certifying an area to be free of contamination. March, 1989.

CHAPTER 8

SEWER WORK

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8.0

SEWER WORK

8.1 Difficulty and Scope of Work.

Sewer work was the most difficult phase of the project. It took 30 days to accomplish, but could have been finished in half that time had the Contractor not had to contend with unanticipated rock excavation and groundwater problems. Since the Contractor was still able to finish the job within the 40 days he had allotted, he did not subsequently pursue any claims for changed conditions. Altogether, sewer work encompassed the following activities:

(1) Sampling and testing to define the extent of sanitary sewer contamination.

(2) Excavation and shoring of an 8-foot deep trench to expose 246 feet of contaminated sewer line beneath E. Stratford Ave., downstream of the confluence with the lateral sewer pipe running from the 105 E. Stratford Ave. residence.

(3) Construction of 246 feet of replacement sewer line with a new manhole beside the existing contaminated line, and hook-up of residential laterals.

(4) Removal of the contaminated sewer line and old manhole, and removal of contaminated soil and rock around the old line.

(5) Removal of shoring and placing compacted backfill in the sewerline excavation.

(6) Construction of a concrete-slab basecourse and asphalt patch over the backfilled excavation.

8.1.1 Sampling and Testing to Define the Extent of Contamination.

8.1.1.1 Contractor Sampling and Testing.

The Contractor investigated the sanitary sewer system for radioactive contamination at the 6 manhole locations shown in Figure 8:1. The sampling consisted of gamma scintillometer measurements of the manhole structures and

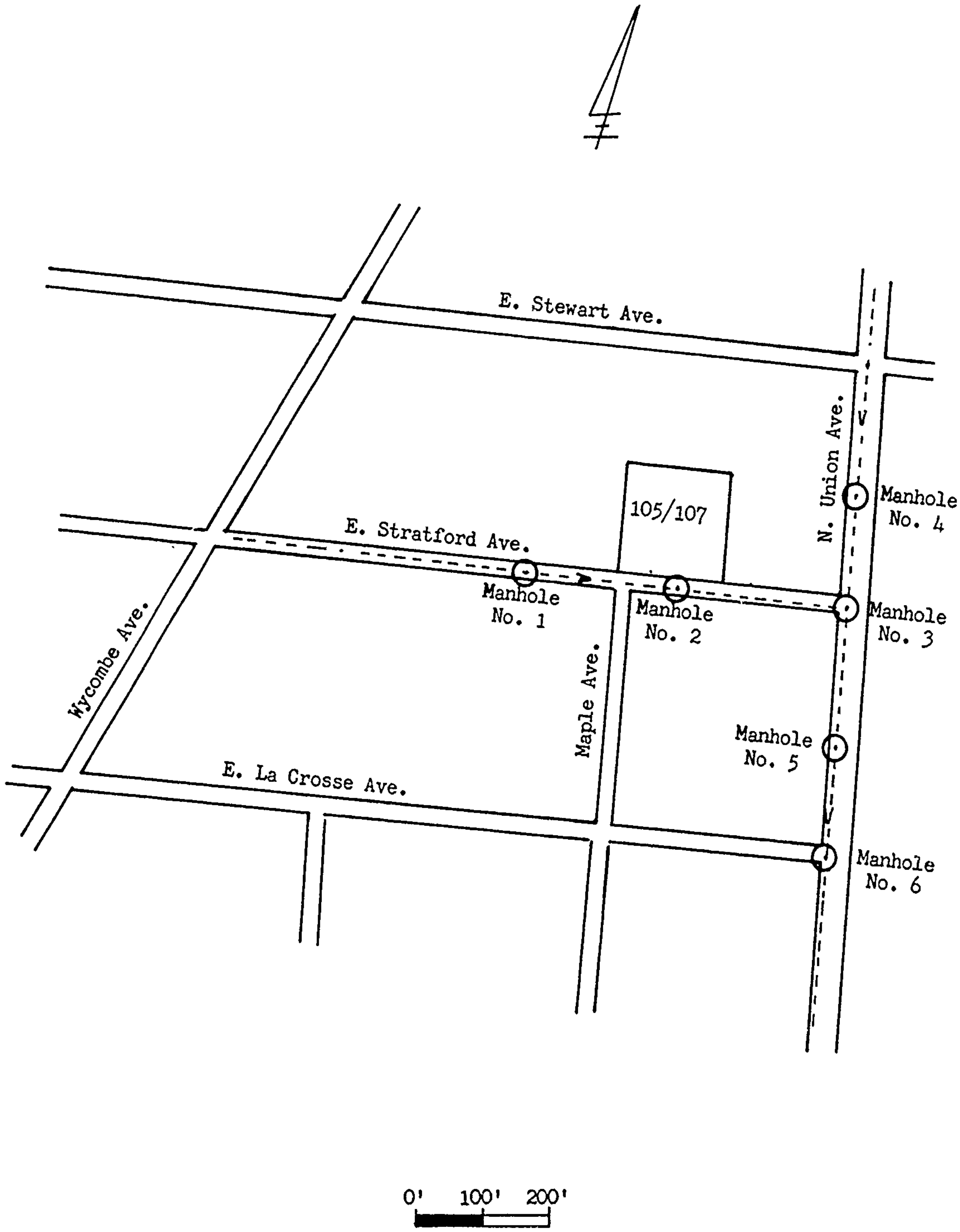


FIG. 8:1 - SEWER SAMPLING LOCATIONS

their accessible sewer connections, loose contamination measurements of same by swipe surveys, and the collection of sludge and sediment from the inverts of the manholes. The Contractor found only Manhole No. 2 on E. Stratford Ave. to be contaminated. Manhole No. 3 at the confluence of E. Stratford and Union Ave. sewers was clean. It was theorized that the large volume of flow in the Union Ave. sewer had flushed away any radioactivity that emptied into it from the E. Stratford Ave. sewer. The Union Ave. sewer was a major trunk line, extending for about 20 blocks upstream of the jobsite. It serviced thousands of residences and commercial enterprises, and flowed at several hundred gallons per minute.

8.1.1.2 Argonne Sampling and Testing.

Acting in their Q/A role, the consulting health physicists from Argonne National Laboratory wanted to satisfy themselves about the validity of the Contractor's findings regarding the Union Avenue sewer. Pursuant to this end, they dragged a gamma scintillometer probe through the Union Avenue sewer between Manhole Nos. 3 and 5, downstream of the confluence with the E. Stratford Ave. sewer. Their aim was to check out sections of the sewer line that the Contractor's earlier investigation did not address. They found what they thought to be only normal background radiation. But just to be sure, they decided to make a comparison with radioactivity levels in the sewer between Manhole Nos. 3 and 4, upstream of the confluence with the E. Stratford Ave. sewer. It was expected that this section of the system would be sure to be free of radioactive contamination since the water in the line did not flow up gradient. But elevated readings (twice the downstream readings) were detected about 70 feet upstream of the confluence with the E. Stratford sewer. A week-long investigation was subsequently undertaken to determine the cause of the anomaly.

8.1.1.2.1 Union Avenue Sewer Anomaly (Fig. 8:2).

The radioactive anomaly detected in the Union Avenue sewer, upstream of its confluence with the E. Stratford Ave. sewer, was either manmade or a natural phenomenon. The thinking was that whatever was being detected was coming from outside the sewer pipe, owing to the large volume of flow inside the pipe and the fact that the sewer did not flow uphill. If the anomaly 70-feet upstream were the result of natural causes, it would not have to be remediated. If it were man-made, it would have to be removed. The worst possible scenario was that the anomaly represented radium contamination that had migratated through the soil from the 105/107 E. Stratford property. If that were true, it would mean that the properties downslope at 115, 117 and 121 E. Stratford Ave. were probably underlain by the contamination as well. Pursuant to addressing that hypothesis, two drill rigs of the Baltimore District, Corps of Engineers were mobilized on site. They drilled four holes in the area of the anomaly and obtained soil samples for gamma spectroscopic analysis. Additionally, the borings were logged with a pulse-height analyzer that identified radionuclides by the energy range of their gamma emissions. The results of this comprehensive study showed conclusively that the anomaly was attributable to naturally occurring radionuclides.

8.1.2 Excavation and Shoring.

8.1.2.1 Factors Controlling the Extent of Sewer Excavation.

Planning the extent of the excavation for the replacement sewer line was dictated not only by how much of the old line was contaminated, but also by certain logistical factors.

8.1.2.1.1 Contamination Factors.

Following the investigation phase of sewer work, it was concluded that contamination only existed in the E. Stratford line. It had to be present in that part of the line extending from Manhole No.2 upstream at least as far as the confluence with the 105 lateral, since that is where the contamination in Manhole No. 2 originated. How far the contamination extended downstream of Manhole No. 2 was not known because ANL was unable to run their gamma probe through the E. Stratford sewer owing to insufficient flow. Contamination in the line might stop at some point upstream of Manhole No. 3, nevertheless, the Government gave the Contractor permission to proceed with plans to take out the entire line between Manholes 2 and 3, whether it was contaminated or not. This was done to avoid having to construct an additional manhole at some point in the line where contamination might stop, as explained below.

8.1.2.1.2 Logistical Factors.

The replacement sewer line had to be in place <u>beside</u> the contaminated line, <u>before</u> the contaminated line was removed, so that residential laterals could be disconnected from the contaminated line and quickly re-connected to the replacement line, in order to minimize the down time for residential service. Since the replacement-line segment had to be offset from the rest of the sewer line to effect this, it necessitated constructing a bend in the replacement line in order to connect it to the original line at the point where it was not contaminated.

Specifications of the Borough of Lansdowne forbade any bends in a sewer line except at locations of manholes.[12] By allowing the Contractor to make plans to run the replacement line from Manhole 3 at the Union Ave. confluence, upstream to the point where contamination in the existing sewer pipe stopped, the Contractor could plan on having to construct only one manhole. As it turned out, he would only have had to construct one manhole in any case, since the E. Stratford sewer was ultimately found to be contaminated all the way down to the last section of pipe connecting to Manhole No. 3, and the 246-foot length of the replacement line did not exceed the 250-foot maximum allowable distance between manholes in the sewer specifications.

8.1.2.2 Description of the Sewer-Line Excavation

The excavation for the sewer line was 8 feet deep, 4 feet wide, and 246 feet long. It cut diagonally across E. Stratford Ave. and exposed a variety of geologic conditions (See Page H-3, Appendix H). From Station 0+00 to Station 0+69, the excavation had to be jackhammered out of weathered schist and gneiss striking roughly N 45 W and dipping 30 NW. Between stations 0+69 and 1+76, the excavation went through a fat, blue-green clay; and between stations 1+76 and 2+46, the excavation went through sand or very sandy soil. The elevation of the excavation grade dropped approximately 9 feet between upstream and downstream ends. The water table daylighted on the excavation floor at Station 1+42. At the confluence with the Union Ave. sewer at Manhole No. 3 (Station 0+00), the floor of the excavation was approximately 2 feet below the water table. Water flowing into the excavation at the extreme downstream end washed out soil along the toe of the sidewalls causing an acute slope stability problem. The sidewalls of the excavation were subsequently shored with two rows of 2x10-inch oak-plank stringers on approximately 4-foot centers, with 2x6-inch fir uprights at approximately 4.5-foot spacing to allow for placement of plywood sheeting between 6x6-inch cross-braces or ditch jacks. A minimum of 3 sheets of plywood per side of excavation were placed along soft sections of the sidewall to protect personnel from falling rock and debris. Access to areas not provided with the plywood protection was restricted.

8.1.3 Construction of the Replacement Sewer Line (Fig. 8:3).

8.1.3.1 Construction Detail.

The replacement sewer-line was 8-inch diameter, vitrified-clay pipe, conforming to the specifications of the Borough of Lansdowne. Individual pipe sections were 5-feet long, with bell and spigot ends. The pipe was bedded on 0.5' - 1.5' of crushed 2-B quartzite. The pipe was laid by starting at the downstream end of the line and proceeding upstream, with the bell end of each pipe section always pointing in the upstream direction. Joints in the pipe were fitted with O-ring seals. The new manhole constructed at the upstream end of the line was of pre-cast concrete complying with ASTM Standard Specification C478 and mounted on a cast-in-place concrete base, 8-inches thick. The line had a uniform drop of 0.44 in./ft., or about 2 degrees between manholes. Constant gradient was determined by checking each pipe section with an inclinometer. Straight alignment of the pipe was verified by a light test, whereby sunlight was reflected off a mirror at the downstream manhole to be seen through the other end of the pipe at the upstream manhole. A pressure test of the line to check for leaks in the joints, which was supposed to have been performed, was not. This is because the Contractor had connected all of the house laterals to the new line as it was being constructed. Disconnection, testing and reconnection were not felt to be prudent or necessary. Lansdowne's Engineer agreed to the deletion of the pressure test.

8.1.3.2 Overcoming Groundwater Problems.

Groundwater created havoc with construction of the replacement sewer line. The first 100 feet of new pipe had to be taken up and re-laid, either because it floated up out of its bedding, or else sank into the bedding owing to a quick soil condition. This caused deformities in pipe gradient and pipe alignment. The floor of the excavation was quite firm immediately after it had been excavated down to grade, but it quickly became a quagmire, owing to the piping of fine soil particles under artesian head and repeated trampling back-and-forth by personnel working in the ditch. Mucking it out only made matters worse, as this exposed the excavation floor to even higher pore-water pressures resulting in even more rapid soil liquifaction. The solution was ultimately found in bedding the line on #57 stone base, encased in filter cloth. Change order "AG" was processed to compensate CNSI for these additional efforts.

8.1.4 Removal of the Contaminated Sewer Line.

The original plan for the removal of the contaminated sewer line had been to pick up the sections of pipe concurrently with connection of the laterals to the replacement line, as progression of the replacement line proceeded from downstream to upstream manholes. The contaminated line, however, was found to have leaked badly at practically every joint, resulting in the spread of contamination into the soil and rock around the pipe. If the old line were removed as originally planned, the fear was that, with workers trampling about in the bottom of the ditch, the contaminated soil around the old line would get tracked over to the other side of the ditch and cross-contaminate the bedding and filter cloth underlying the replacement line. To avoid this, contaminated soil lying to the replacement-line side of the contaminated pipe was first removed before the replacement line was laid. The old contaminated pipe, which had loose contamination only on its inside and on exterior surfaces not exposed to the air, was then left to shield the remaining contaminated soil from contact by the workers. When the replacement line was completely operational, the contaminated pipe was taken up, and the remainder of contaminated soil removed.

8.1.4.1 Problems Encountered during Removal of the Contaminated Sewer Line.

Sections of contaminated pipe took seconds to remove from the excavation and place in a rad-waste bin. Clean-up of contaminated soil around the pipe was over in a matter of days. Where the pipe was underlain by rock, removal of the contamination took weeks. Fortunately, those areas of rock were above the water table. The weathered rock was porous enough to allow migration of fluids that leaked from joints in the sewer pipe, yet still competent enough to require excavation with a jackhammer.

An identification problem also contributed to the slower pace of the clean-up in bedrock areas. Whenever elevated radioactivity was detected, RADCON had to

be sure that it was from Radium-226 and not the naturally occurring radionuclide Potassium-40. To distinguish radioactive emissions of K-40 from Ra-226, a portable pulse-height analyzer was used, which took several minutes to make its measurements. When the pulse-height analyzer identified Ra-226, a jar sample of the rock would be collected and analyzed in the field laboratory by gamma spectroscopy to quantify the Ra-226 activity in pCi/g.

When the results of the spectroscopic analysis showed the activity of the sample to be above 5 pCi/g (which was the typical case), a layer of rock several inches thick, from which the contaminated sample was collected, would be jackhammered away. The freshly exposed rock surface underneath would then be rechecked with the pulse-height analyzer, and if elevated radium readings were still detected, the entire procedure would be repeated.

It began to appear as though the release criteria of 5 pCi/g above background would be difficult to attain. Small-diameter tunnels, created by the removal of contaminated rock, began to extend into the south excavation sidewall, heading toward the residential properties several yards away. Just before it would have been necessary to excavate and stockpile tons of non-contaminated overlying material in order to be able to continue to access the contaminated rock with the jackhammer, the spread of contamination through the rock ended.

8.1.5 Backfilling (Fig. 8:4).

8.1.5.1 Criteria for Backfill Material.

In order to avoid engineering problems associated with some clayey soils (poor drainage, expansion, consolidation, etc.) the Contractor was directed to backfill the sewer excavation with a sandy soil having good compaction characteristics. That meant that he had to dispose of all the clay he removed from the excavation and bring in suitable backfill material from an off-site borrow area. The problem of getting rid of the clay was simplified when a local resident a few houses away from the jobsite asked to use it to fill in a vacant lot next to his house.

8.1.5.1.1 Source of Borrow.

The Seegar Borrow Pit, in Sicklerville, N.J., about 40 miles away, was ultimately selected to provide the type of sandy soil desired for backfilling the sewer excavation and all other excavations on the jobsite. This soil acquired the local name "New Jersey Gold" by virtue of its color and outstanding construction properties. Only 27% of its composition by weight consisted of soil particles in the silt and clay-sized range. It had a natural moisture content of 13.6% and an optimum moisture content of 13.4%, so the

Contractor had no difficulty in compacting it to maximum dry density. When walking on a compacted fill constructed of this soil, it felt like walking on concrete. No footprints were left. Compaction and gradation curves for this soil appear in Appendix D.

8.1.5.2 Compaction.

Contract specifications required the Contractor to place backfill in 8-inch lifts and compact to 95% maximum dry density by Standard Proctor. The upper 12 inches of backfill under foundations and pavements was compacted to 98% maximum dry density. Compaction in the sewer excavation was achieved using a Bomag roller and/or hand tamper. Attainment of compaction specifications was certified by Pittsburgh Testing Laboratories, using a nuclear density meter (Appendix D).

8.1.6 Construction of the Concrete Basecourse and Asphalt Pavement Patch.

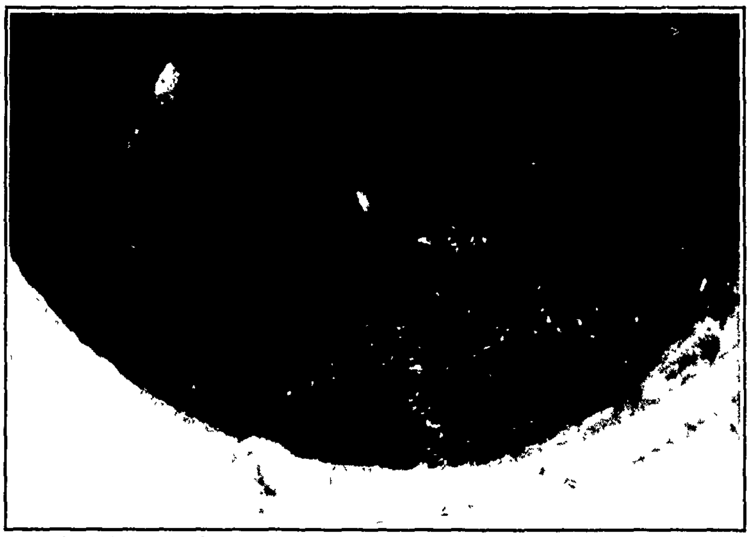
8.1.6.1 Concrete Basecourse.

Where a sewer was overlain by pavement subjected to vehicular traffic, construction specifications of the Borough of Lansdowne required that the pavement have an 8-inch basecourse of 3,300 psi, PennDOT Class A concrete. [13] In accordance with that specification, concrete filled the sewer excavation between the 4-inch and 12-inch depth below the pavement surface. No concrete cores of the basecourse were taken and tested to determine that the strength requirements had been met. As a substitute for testing, the Borough Engineer allowed the Contractor to use a certified mix.

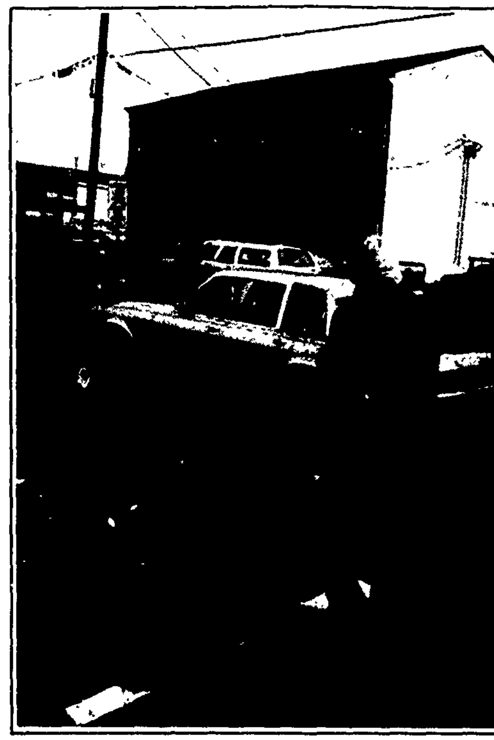
8.1.6.2 Asphalt Pavement Patch.

The last 4 inches of the sewer excavation were topped off with an ID-2 bituminous binder course. The Contractor utilized a binder course rather than a wearing course because he intended to re-pave the entire street between Maple and Union Avenues, as part of Site Restoration.

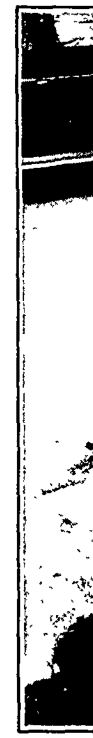
Fig. 8:2 - Investigating the Radioactive Anomaly in the Union Avenue Sewer



a. Fishing line attached to a cork was floated through the sewer between the two manholes immediately upstream of the confluence of the Union and E. Stratford Ave. sewers.



b. Cork and fishing line were snagged and retrieved at the downstream manhole.



c. Rope v
downstre
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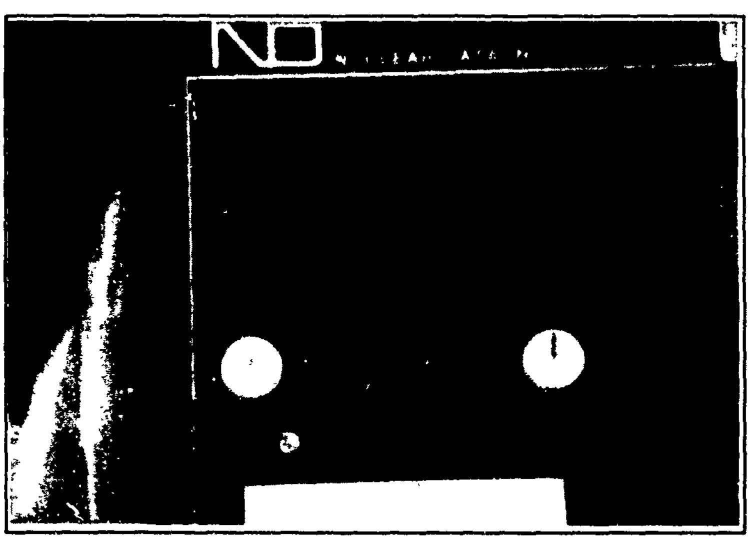
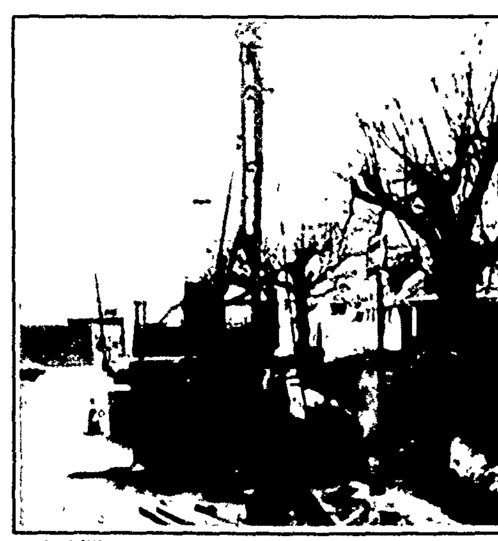


f. The peak on the spectrograph of the multi-channel analyzer indicated that the dominant radionuclide was naturally occurring Potassium-40.



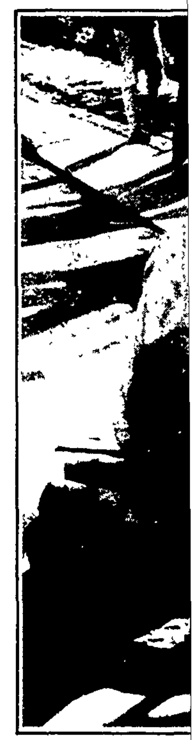
g. A drilling rig was brought in to obtain soil and rock samples around the anomaly.

h. Soil

line were snagged and
nstream manhole.

c. Rope was tied to the fishing line at the downstream manhole, and the line was pulled back through the sewer to the upstream manhole, to leave the rope strung through the sewer between manholes.

d. At the upstream manhole, the rope running through the sewer between manholes was tied to one end of the gamma probe for pulling it through the sewer in the downstream direction. Another length of rope was tied to the gamma probe for pulling it back through the sewer in the upstream direction.

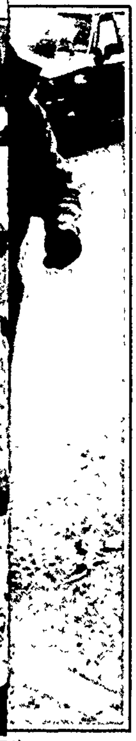


e. The 250-foot ca
pulled through th
multi-channel pul
calibrated to dete
range of radium.

brought in to obtain soil and
d the anomaly.

h. Soil and rock samples also showed no radium contamination.

i. The investigation was not without proble
being used to pull the gamma probe throu
hands of the technician and plugged the s
manhole onto Union Avenue.



the
s pulled
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ugh the

d. At the upstream manhole, the rope running through the sewer between manholes was tied to one end of the gamma probe for pulling it through the sewer in the downstream direction. Another length of rope was tied to the gamma probe for pulling it back through the sewer in the upstream direction.

e. The 250-foot cable on the gamma probe being pulled through the sewer was connected to a multi-channel pulse height analyzer, which was calibrated to detect radioactivity in the energy range of radium.

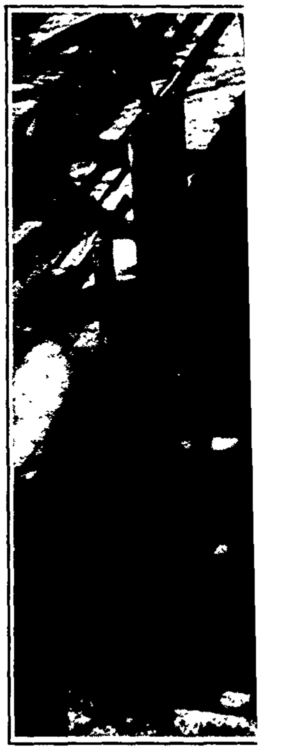
ed no radium contamination.

i. The investigation was not without problems, such as when the rope being used to pull the gamma probe through the sewer slipped out of the hands of the technician and plugged the sewer, causing it to overflow the manhole onto Union Avenue.

FIG. 8:3 - Sequence of Sewer Work (April, 1989)

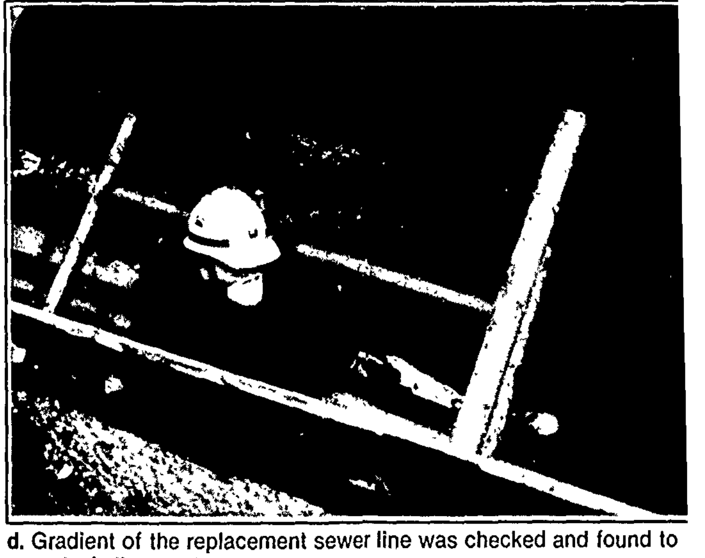
a. 4-foot wide trench was excavated and shored to expose the existing contaminated sewer line (right) and provide space for laying the replacement sewer line beside the existing line (b.). Photo taken facing downstream (east).

c. Replacement sewer line (d.) was laid beside existing contaminated line (b.). Photo facing upstream (west).



e. Replacement sewer lin because of misalignment

b. The concrete foundation for the new manhole was poured and the upstream bend in the existing sewer line accomplished.



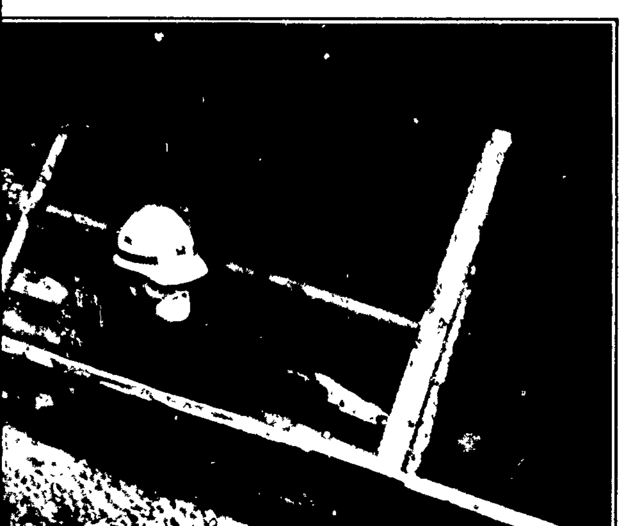
d. Gradient of the replacement sewer line was checked and found to be out of alignment.

line (d.) was laid beside
line (b.). Photo facing

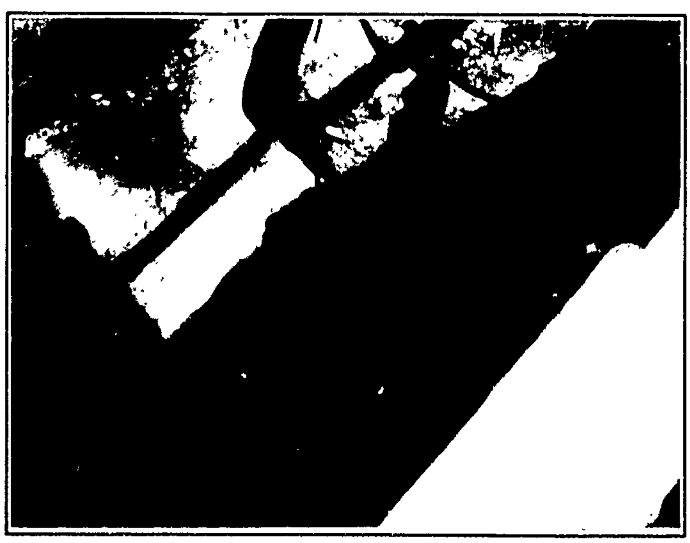
e. Replacement sewer line was taken up because of misalignment.

g. Filter fabric was quickly laid on the floor of the mucked out excavation.

i. Replacer
crushed st



dient of the replacement sewer line was checked and found to
of alignment.



f. Bottom of the excavation was mucked out to a firm substratum.

h. Crushed stone was
foundation for beddir

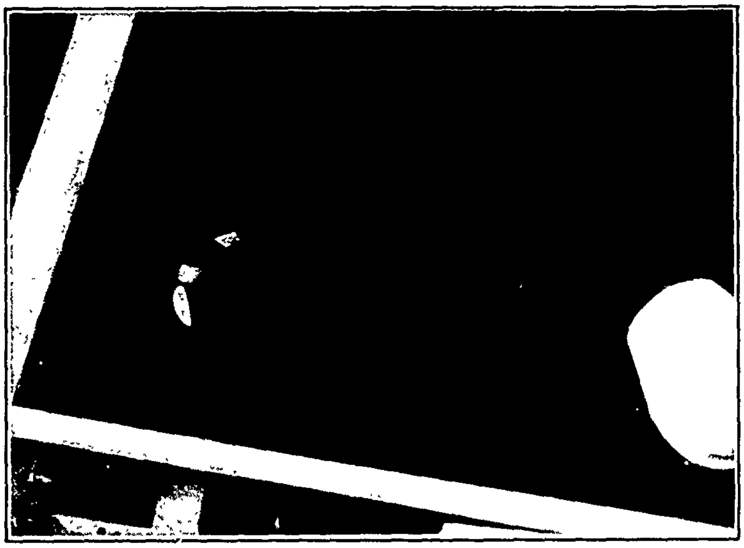
r lin up
ng

g. Filter fabric was quickly laid on the floor of the mucked out excavation.

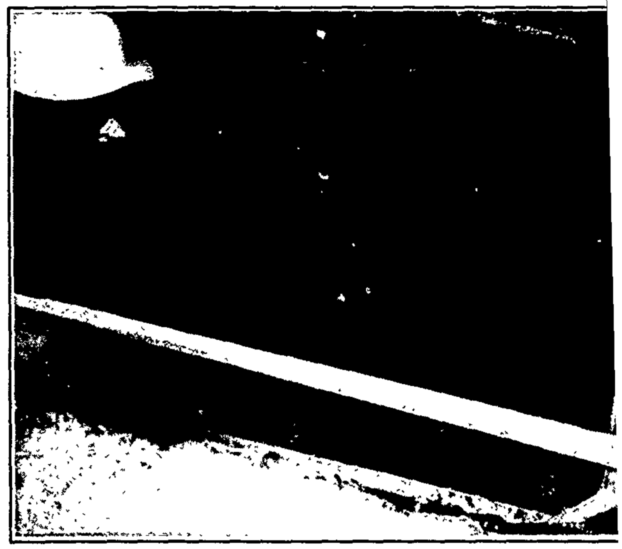
i. Replacement sewer line was re-laid upon the crushed stone bedding.

er ottom of the excavation was mucked out to a firm substratum.
ace

h. Crushed stone was placed over the filter fabric to afford a firm foundation for bedding the replacement sewer line.



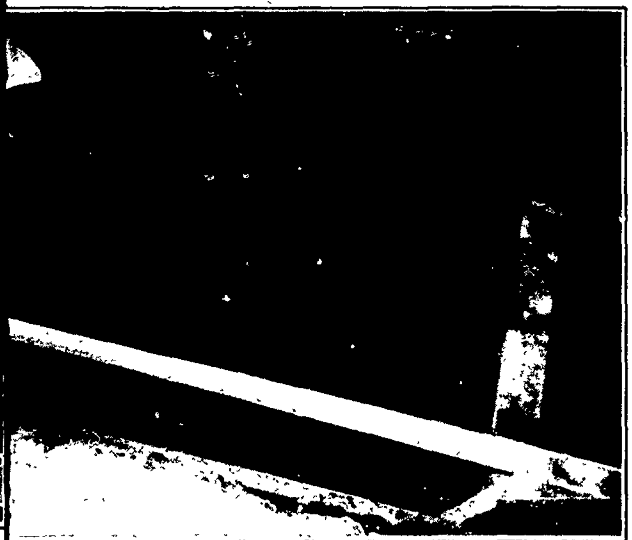
j. Residential laterals were connected up to the replacement line.



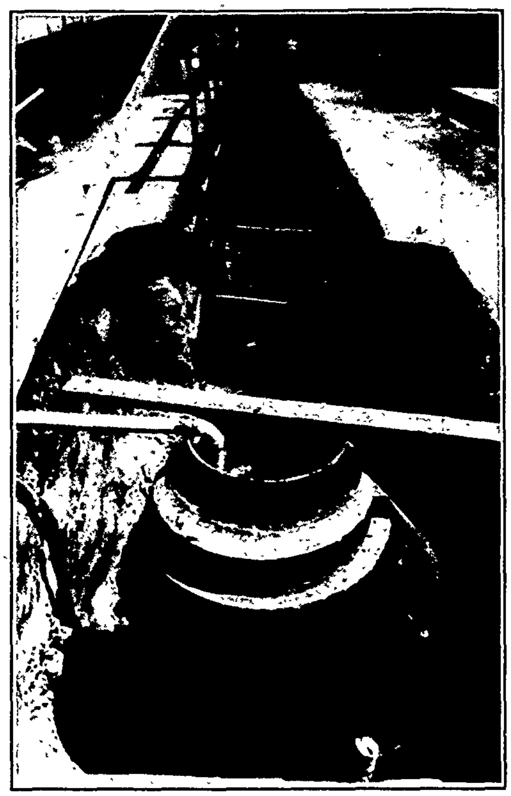
k. The replacement line was buried under 6 more inches of cru

n. The excavation was backfilled in 8-inch lifts with silty sand.

o. Backfill was compacted to 95%-98% maximum dry density.



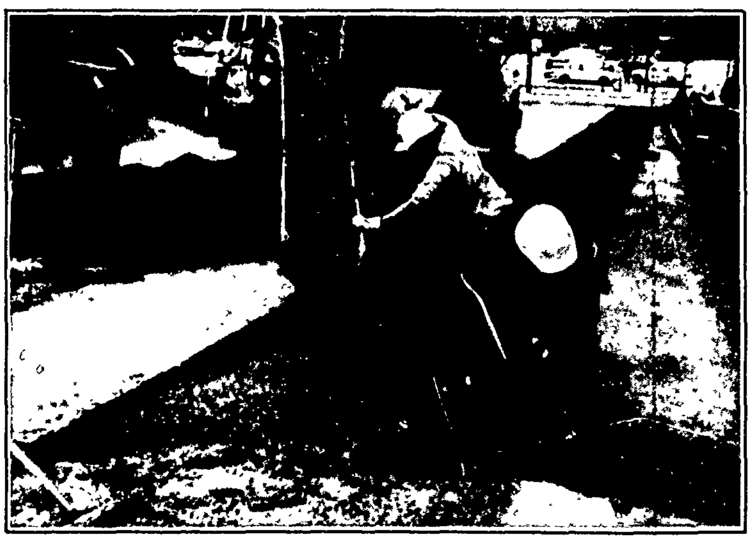
cement line was buried under 6 more inches of crushed stone.



l. The ends of the filter cloth were spread out to overlap the French drain encasing the replacement sewer line. Construction of the new manhole was also completed.

m. The old contaminated sew had leaked out of the line wa removed.

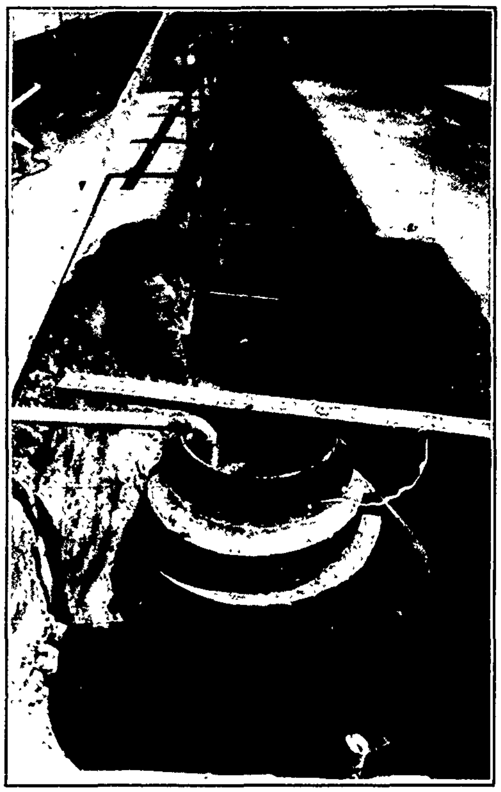
compacted to 95%-98% density.



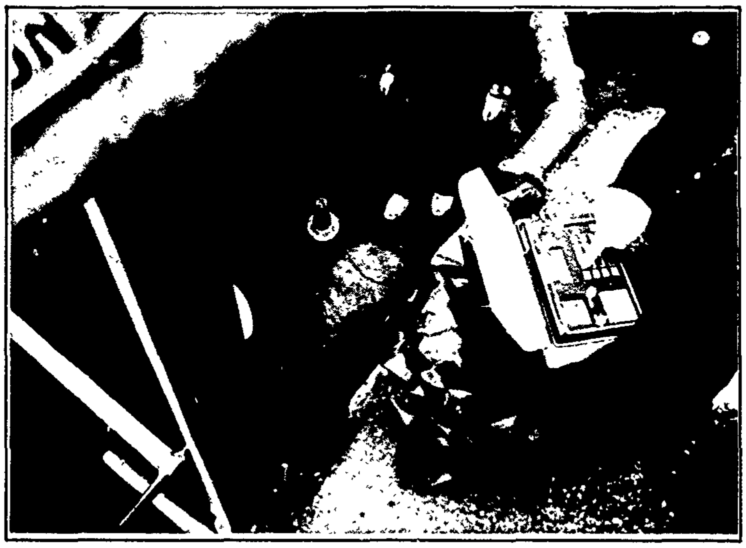
p. An 8-inch concrete cap was placed over the backfill.

q. A 2-inch asphalt binder cou grade.

Fig. 8:4 – Seq



l. The ends of the filter cloth were spread out to overlap the French drain encasing the replacement sewer line. Construction of the new manhole was also completed.



m. The old contaminated sewer line was taken up. Contamination which had leaked out of the line was located with a pulse-height analyzer and removed.

e cap was placed over the backfill.

q. A 2-inch asphalt binder course brought the excavation back to original grade.

Fig. 8:4 - Sequence of Sewer Work (Continued). April, 1989

CHAPTER 9

SITE RESTORATION

9.0

SITE RESTORATION

9.1 Scope of Work.

Site Restoration encompassed the following activities:

(1) Backfilling areas from which contaminated soil was removed.

(2) Construction of two replacement garages at 110 and 112 E. Stewart Ave.

(3) Construction of replacement sidewalks, curbs and driveways.

(4) Landscaping.

(5) Resurfacing E. Stratford Avenue between Maple and Union Avenues.

(6) Disposal of chemical hazardous waste.

9.1.1 Backfilling (Fig. 9:1).

9.1.1.1 Borrow Material.

The clean soil used to backfill areas where contaminated soil was excavated was the same described for backfilling the sewer excavation. A total of 6776 tons of soil, transported to the site in 271 dump trucks, was required to bring the site back up to approximately pre-excavation grade. That is about 2600 tons more soil than was excavated and disposed of as radioactive waste. The increase in backfill quantities over excavation quantities can be attributed to the higher unit weight of the backfill soil--123 lbs./cu. ft. versus 109 lbs./cu. ft. for the native soil, and the fact that areas on the 105/107 property where the driveways and residential basement formerly stood were backfilled to the surrounding grade level. The backfill soil was further densified to around 128 lbs./cu. ft. by compaction. Natural radioactivity in the backfill soil, resulting from Ra-226 and Th-232, was about 0.3 pCi/g. That is about 1.2 pCi/g below the background activity of the adjacent native soil. From the standpoint of radioactivity, the backfilled site is therefore "cleaner" than it naturally was prior to Dr. Kabakjian's activities.

9.1.1.2 Backfilling Procedures.

Backfilling commenced by grading and levelling off all ditches and pits left by the excavation of contaminated soil. This created a large bowl-like depression over the site. From its deepest point (where the 105 basement formerly stood) the sides of the depression sloped gently outward to intersect adjacent properties at original grade. The native soil on the floor of the smoothed-out depression was compacted to 95% maximum dry density, by Standard Proctor, before the borrow material was placed. Borrow was placed in 8-inch lifts and compacted to between 95% and 100% maximum dry density, utilizing a Hyster VE-7, 10-ton, smooth-wheeled, vibrating roller.

As the site was brought up to former grade, it was crowned along a line running SE to NW through the center. This was done to split the run-off between E. Stratford and Union Avenues. The west boundary of the 105/107 lot was about 5-feet higher than the east boundary. Had the site not been crowned, it would have caused all run-off to flow toward Union Avenue, through the backyards of 115, 117 and 121 E. Stratford Avenue.

9.1.1.3 Problems during Backfilling the Site.

9.1.1.3.1 Rain.

It took only 10 working days to backfill the site. However, the month of May, 1989, was one of the wettest on record, so the 10 working days were spread over a four-week period. During this time, there were three rainstorms, each of which dumped over 2-inches of rain into the bowl-shaped depression. After each rainstorm, it took about three days to drain off the standing water and get the fill sufficiently dry to resume placing 8-inch lifts.

9.1.1.3.2 Ground Vibrations.

Minor ground vibrations, generated by the Hyster vibrating roller, rattled window panes in houses next to areas where the backfill was being compacted. The resident of the house at 112 E. Stewart Avenue even claimed that the vibrating roller cracked the plaster in his ceilings. An inspection of the ceilings by the Government showed that the cracked portions had previously been spackled, meaning that the cracks were probably caused by structural defects in the ceilings. No other residents of the neighborhood complained of similar damage.

9.1.2 Replacement Garage Construction.

The two replacement garages at 110 and 112 E. Stewart Avenue were intended to be replicas of the garages which were removed during soil excavation. That the new garages look to be almost exact replicas of the garages that were destroyed to remove contaminated soil is a tribute to the building subcontractor, Dick Baker, who had to get his cues mostly from photographs of the old garages, while still conforming to all applicable codes. When viewed from the outside, the only thing that looks different about the replacement garages are the metal roll-up doors which the owners specifically requested to replace the hinged wooden-doors on the former garages. On the inside of the replacement garages, however, 1/2-inch plywood replaced the 1"x4" wooden planks on the old garage walls. Also, nominal-size 2"x4" wall studs replaced the old actual-size 2x4's, and 2"x10" nominal-size raffters replaced the old real sized 2x6's. Lumber cut to antique dimensions could not be obtained to exactly replicate the former structures. Photographs of replacement garge construction are provided in Fig. 9:2 at the end of the Chapter.

9.1.2.1 110 E. Stewart Garage.

9.1.2.1.1 Problems with the Old 110 Garage.

The old 110 E. Stewart Garage was a 18'x20' structure with a 16-foot peak. It was built upon a 6-inch, unreinforced, concrete floor slab that had not been rigid enough to prevent the structure from undergoing severe differential settlement. The east side of the slab overlapped Disposal Site "A" by about a foot, where some of the buried radioactive garbage and ashes were discovered. The east wall of the old 110 garage had settled up to 18-inches into the ash pit because the loose layer of ashes under the slab either sheared or compressed under the superimposed load, and the edge of the slab was not strong enough to keep from breaking off. The remainder of the garage was underlain by a fat clay of undetermined thickness which was prone to long-term consolidation. These factors caused the 110 garage floor slab to crack all over, and the garage to undergo varying amounts of differential settlement all around its perimeter.

9.1.2.1.2 Foundation Preparation for the 110 Replacement Garage.

It was decided by the Government to put the 110 replacement-garage on a continuous strip-footing foundation. The base of the footing would be at the 3-foot depth, just below the frost depth for the Philadelphia region. It was assumed (correctly, it turned out) that after removing clay to the 3-foot depth, the foundation excavation would still be in clay. The Government therefore wanted to remove the clay to such depth, that, upon backfilling the excavation with compacted sandy soil to the elevation of the base of the footing, any clay, still underlying the footing at depth, would undergo only

negligible consolidation as a result of the load it would receive by construction of the new garage. This was especially important because the replacement garage was to be moved about 10 feet west of the location of the former structure, so the clay beneath the new location had not experienced any consolidation from being stressed by the former structure. To estimate the depth to which unsuitable clay would have to be removed, the Project Engineer performed a settlement analysis (Appendix E), making conservative assumptions about the thickness of the clay layer and its engineering properties. [14] Based on that analysis, the Contractor was directed to remove the clay beneath the location of the garage to the 9-foot depth, and backfill the excavation to surface grade with sandy soil in 8-inch lifts, compacted to at least 98% maximum dry-density. The Project Engineer's settlement analysis indicated that when the footings were constructed at the 3-foot depth on the compacted backfill, only about 5% of the garage load at the base of the footing would be felt by the clay at the 9-foot depth. This could be expected to result in no more than a half-inch of settlement over a 30-year period, which was considered acceptable for residential construction.

9.1.2.1.3 <u>110 Garage Construction Specifications.</u>

The continuous strip footing was constructed of 3000 psi concrete, reinforced by three rows of #4 steel rebar. The poured-concrete bottom portion of the footing was 24-inches wide and 24-inches thick. The upper portion of the footing consisted of two rows of 8-inch concrete blocks. The upper row of blocks extended 6-inches above grade and was flush with a concrete floor slab of the same thickness, reinforced with 6"x6" welded wire fabric. The bottom wall plates of the garage were bolted to the upper row of foundation blocks, using 1/2-inch diameter grouted-in anchor bolts. The 2"x4" wall studs were nailed to the wall plates on 16-inch centers. Specifications for garage construction appear in tabulated form on the proposal of the building subcontractor (Appendix F).

9.1.2.2 <u>112 E. Stewart Garage.</u>

The replacement garage at 112 E. Stewart Avenue was a 20'x20' structure with a 15-foot peak. It was constructed of the same materials and had the same type of foundation detail as the 110 E. Stewart garage, except in the case of the 112 garage, it was not necessary to remove any unsuitable soil beneath the base of the continuous strip footing. The foundation excavation for the 112 garage was dug out of the compacted sandy-soil backfill. Beneath the base of the footing at the 3-foot depth, there were about two more feet of backfill, underlain by weathered schist and gneiss-- materials not prone to consolidation and certainly strong enough to resist shear failure when subjected to the load of the garage.

The location of the 112 replacement garage was translated about 14 feet south of the location of the former garage. This was done at the request of the owner, who desired more backyard space between the garage and his house. The

owner wanted the rear wall of the replacement garage to go right on the property line in order to maximize the additional space he would receive, but it had to be set back three feet from the property line in order to conform to a Lansdowne Borough ordinance.

As with the 110 Garage, the award of the contract to build the 112 Garage was based on the evaluation of proposals submitted by four bidders. The only requirements imposed on the bidders were that the replacement structures should replicate the former structures to the extent possible, and the replacement structures must meet the requirements of the BOCA Building Code and any other codes or regulations adopted by the Borough of Lansdowne. The construction specifications written into the proposal of the successful subcontractor appear in Appendix F.

9.1.2.3 Waiver of Height Limitations Imposed by the Borough of Lansdowne.

The garages which were demolished during site remediation were constructed prior to the enactment of an ordinance by the Lansdowne Borough Council that limited the height of such structures to no more than 12 feet. In order to replicate the demolished structures, the 110 E. Stewart garage would need to be 15-feet high, and the 112 E. Stewart garage would need to be 16-feet high. The matter was brought before the Lansdowne Borough Council at one of their scheduled meetings, whereupon a written dispensation from the height restriction was granted (See Appendix C).

9.1.2.4 Alleged Misalignment of the 112 E. Stewart Garage.

After the foundation of the 112 Garage had been constructed, the owner of the property complained that it was crooked with respect to the alignment of his house 60 feet away. As a result of this complaint, the buildings on the property were surveyed by Catania Engineering Associates, who found that the east and west walls of the garage deviated 0.28 feet in the direction east of north over a distance of 20 feet. The same walls of the adjacent house were found to strike due north. The Government considered the amount of deviation in the alignment of the garage walls to be acceptable for residential construction.

In reality, what had happened with regard to the orientation of the replacement garage was that it had been straightened out compared to the orientation of the former garage. This was inadvertently done in the process of relocating the replacement garage 14 feet south of the location of the former garage, at the request of the property owner. When the replacement garage was constructed, it did not occur to anyone, including the property owner, that the old garage did not have the same orientation as the house. After the replacement garage was constructed, the owner sensed that something was different. A check of pre-dismantlement photographs then showed the west walls of the house and old

garage to be aligned in different directions. On post-reconstruction photographs, taken from the same vantage point, the same walls appear perfectly aligned. A transit is needed in order to determine that there is a negligible deviation in the wall of the garage. Nevertheless, the EPA Public Affairs Office was contacted about the matter by the property owner's attorney, but nothing ever subsequently came to pass.

9.1.3 Construction of Replacement Sidewalks, Curbs and Driveways.

It was necessary to replace sidewalks, curbs and driveways, either because such structures had been unavoidably damaged by the Contractor in the course of site remediation, or they had to be removed because they were underlain by contaminated soil.

9.1.3.1 Replacement of Sidewalks and Curbs as a Result of Contaminated Soil Removal.

Sidewalks and/or curbs, removed in the course of contaminated soil excavation, were located in front of 110, 105/107, and 115 E. Stratford Ave. Altogether, approximately 210 feet of sidewalk and 80 feet of curb were involved. Curbs were 18-inches thick; sidewalks were 4-inches thick and were underlain by a free-draining, granular basecourse, compacted to 98% maximum dry density. Thickness of the basecourse varied, depending on the depth to which contaminated soil had to be removed under the sidewalk, but in no case was it less than 6 inches. Concrete used for sidewalks and curbs was unreinforced and had a strength of at least 3000 psi. In all respects, construction of replacement sidewalks conformed to the specifications of the Borough of Lansdowne. [15]

9.1.3.2 Replacement of Damaged Driveways and Parking Slabs (Fig. 9:3).

The driveways and parking slabs at 110 and 112 E. Stewart Avenue were badly damaged from being crossed by the Contractor's forklift carrying B-25 boxes loaded with soil. The Government paid for the cost of replacement since it had put the Contractor in the position where he had no way to access or egress areas underlain by contaminated soil on the E. Stewart properties, except by utilizing the driveways. The boxes of contaminated soil would be carried off the E. Stewart properties via the driveways, and then driven around the block to be stored inside the jobsite security fence, pending shipment to the disposal area. There was no other way to transport contaminated soil off the E. Stewart properties, because the huge pit left in the backyard of the 105/107 E. Stratford property by the First Argonne Subsurface Investigation could not be crossed from the south to reach the E. Stewart properties. The Contractor never would have created such a barrier had he not been required to do so by the Government.

Replacement driveways and slabs were constructed of 3000 psi concrete, 4-inches thick, reinforced with 6"x6" welded wire fabric. The concrete was placed over a 4-inch basecourse of crushed 2-B limestone. Each of the driveway/parking slab units was approximately 100 feet in length. Expansion joints were constructed at 20-foot intervals.

9.1.4 Landscaping (Fig. 9:4).

Landscaping was performed by the local subcontractor, Eagle Tree Service. It involved placing 4 inches of topsoil on those parts of residential and municipal properties that had been backfilled with compacted sandy soil, seeding the topsoil with fescue grass, and replacing, with nursery stock, the trees that had been cut down on properties adjacent to 105/107 E. Stratford Avenue.

9.1.5 Re-surfacing E. Stratford Avenue.

Following site remediation, the pavement on E. Stratford Avenue, extending between Maple and Union Avenues, was disfigured by a 6-foot wide asphalt patch that marked the location of the sewer excavation. Also, the street was pocked with a couple of dozen small-sized (1'x1') asphalt patches, that marked spots where contamination had been chipped out o. the pavement. Although the street was serviceable in that condition, it would have detracted from the quality of the finished product. The Contractor was concerned about the impact the disfigured pavement would have on his reputation for doing quality work. He therefore repaved the entire roadway width at his own expense. The new bituminous service was an ID-2 wearing course, 3-inches thick, compacted to at least 95% Marshall density, in accordance with PennDOT specifications.

9.2 Disposal of Chemical Hazardous Waste (Fig. 9:5).

Removal of chemical hazardous waste from the site coincided with the period when Site Restoration neared completion.

Stored in the basement of the 105 E. Stratford residence were some 55-gallon drums containing cans and bottles of paint, solvents, household chemicals, and unknown liquids. Some of the containers were radioactive, so they could not be sent to a chemical-waste disposal facility. But because the radioactive containers held chemicals, they could not be sent to the radioactive-waste disposal facility either. That problem was solved by transferring the chemicals to non-radioactive containers, then disposing of the empty radioactive containers as rad-waste.

The next step was to get rid of the chemicals. Pursuant to that end, proposals were solicited from several qualified firms, with GSX Services, Inc., of Laurel, Maryland, subsequently being awarded the contract to do the work. GSX first inventoried all of the items and prepared a manifest which designated each of the 160 containers with a number, a description of its contents (if known), and the size of the container. Next the items were segregated into such classifications as poisons, corrosives, flammable solids, flammable liquids, flammable gases, unknown liquids, etc. This had to be done for two reasons: (1) Some chemicals with different classifications could not be shipped together. (2) Different disposal facilities were set up to handle different classifications of chemicals.

The chemical waste containers, which altogether had been stored in two 55-gallon drums pending their removal from the site, ended up leaving the site in three separate trucks, heading for three separate destinations in North Carolina, Maryland, or Arizona. All of the chemical wastes, whatever their classifications, were disposed of by incineration. No attempt was made to identify the unknown liquids, though some of their physical properties such as specific gravity, flash point, etc., were determined before they were destroyed.

Fig. 9:1 - Stages in Backfilling the Site. May-June, 1989.

a. An Allis-Chalmers AC-7 front-end loader smoothed out the excavation grade to create a bowl-Like depression.

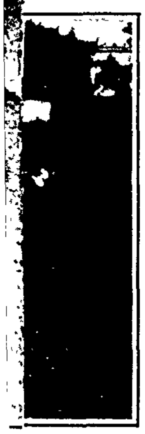
b. A Hyster VR-7 vibrating roller compacted the smoothed out excavation floor to 95% Proctor.

c. 221 trucks brought in 6776 tons of soil to backfill the site.

d. The backfill was compacted in 8-inch lifts to at least 95% Nuclear density tests were performed on each lift to ensure t compaction standards were being met.

e. Sand-cone tests were also performed on the compacted ba ensure the reliability of the results obtained with the nuclear d

cavation



cavation

d. The backfill was compacted in 8-inch lifts to at least 95% Proctor. Nuclear density tests were performed on each lift to ensure that compaction standards were being met.

e. Sand-cone tests were also performed on the compacted backfill to ensure the reliability of the results obtained with the nuclear density meter.

g. The topsoil was spread out in a 4-inch layer, seeded and mul

f. When the site had been brought up to near final grade, topsoı brought in.

h. An erosion control blanket was placed on the slope in front o 105-107 E. Stratford property.

:ted in 8-inch lifts to at least 95% Proctor.
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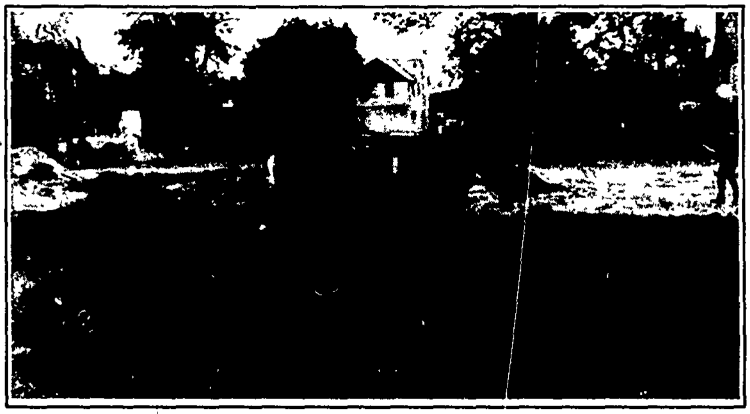
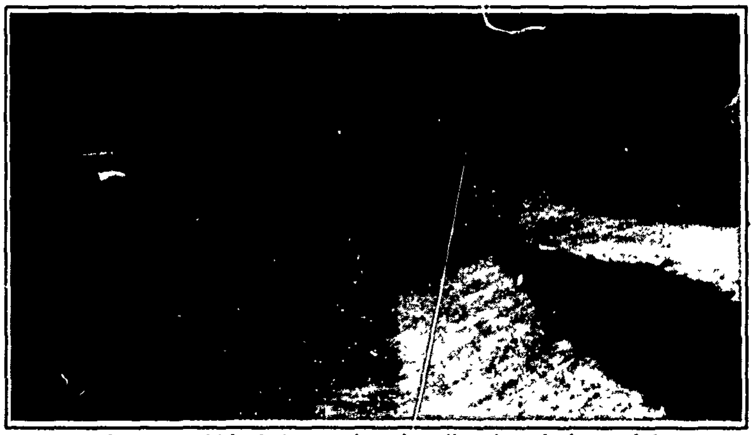
results obtained with the nuclear density meter.

g. The topsoil was spread out in a 4-inch layer, seeded and mulched.



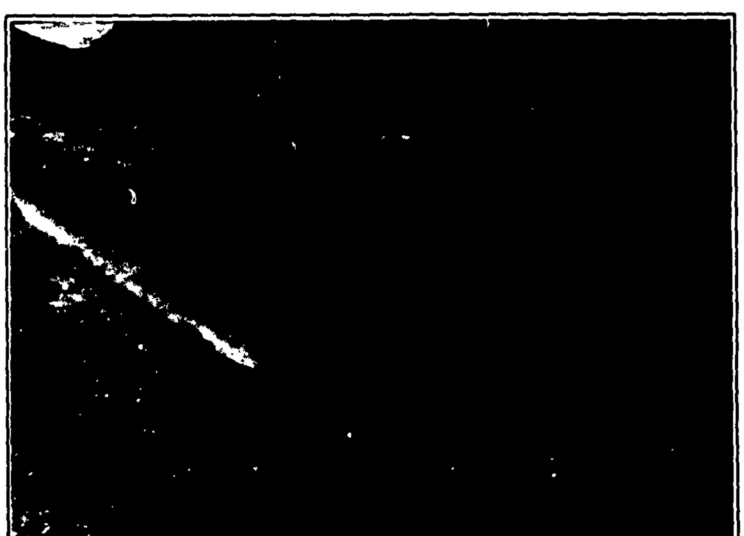
f. When the site had been brought up to near final grade, topsoil was brought in.



h. An erosion control blanket was placed on the slope in front of the 105-107 E. Stratford property.

a. Former garages at 110 and 112 E. Stewart Ave. The 110 garage at right shows the effects of differential settlement from being partly constructed over the 17th Century Swedish root cellar (See Fig. 7:5). Photo taken facing south, April, 1989.

b. Removal of soft clay beneath the new location of the
The excavation was backfilled with sand, compacted in
taken facing west, May, 1989.



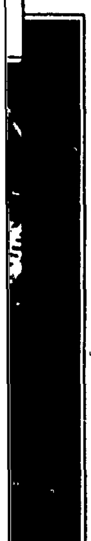
e. The bottom part of the continuous strip-footing foundation was reinforced concrete, 24-inches thick. May, 1989.

f. The upper part of the foundation consisted of concrete

ight
cted
acing

b. Removal of soft clay beneath the new location of the 110 garage created an excavation 9-feet deep. The excavation was backfilled with sand, compacted in 8-inch lifts to 98% maximum dry density. Photo taken facing west, May, 1989.

c. A 3-foot deep by 24-inch wide exca
made in the compacted backfill for a
strip footing. Disturbed soil on the flc
footing excavation was re-compacted
hand tamper. May, 1989.



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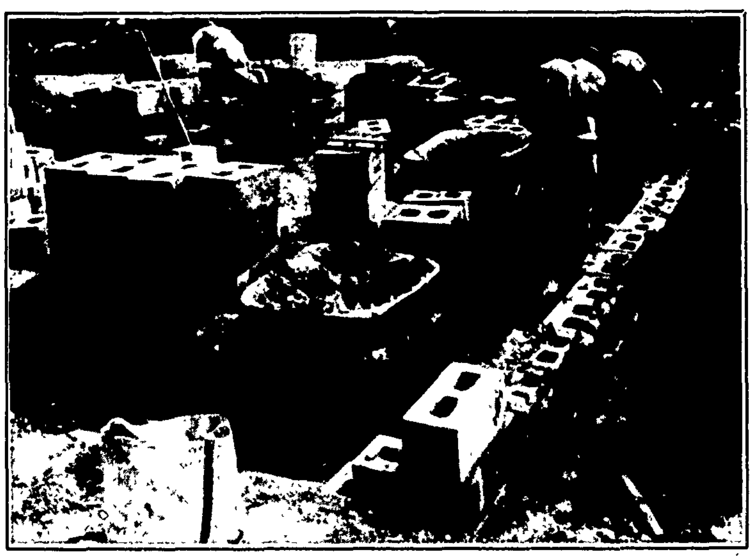
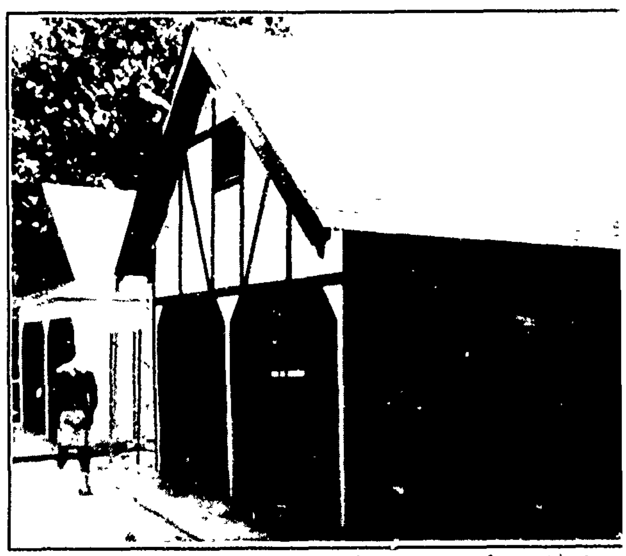
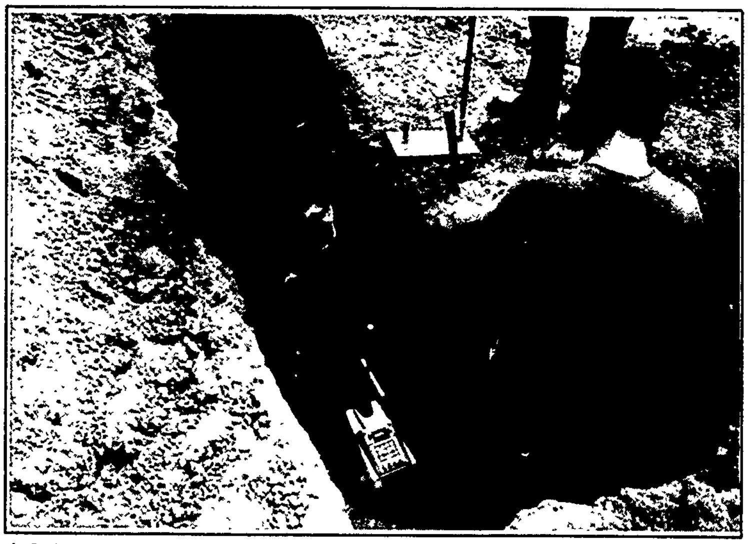


f. The upper part of the foundation consisted of concrete blocks. May, 1989.

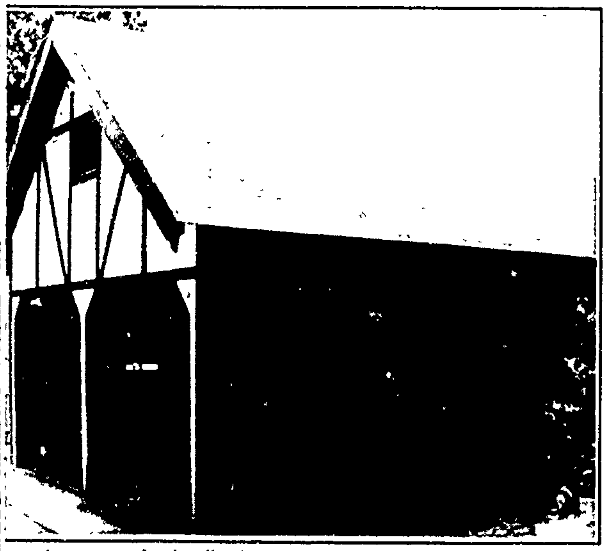


g. The replacement garages in the final stages of construction

c. A 3-foot deep by 24-inch wide excavation was made in the compacted backfill for a continuous strip footing. Disturbed soil on the floor of the footing excavation was re-compacted with an hand tamper. May, 1989.



d. Soil at the base of the footing was compacted to at least 98% maximum dry density. The determination that compaction standards had been met was made with a nuclear density meter. May, 1989.



ment garages in the final stages of construction. July, 1989.

Fig. 9:2 - Replacement Garage Construction
The garage at 112 E. Stewart Ave. had to be dismantled because it was contaminated. The garage at 110 E. Stewart had to be demolished in order to clean out the contaminated rubbish filling the old root cellar over which it was built. Except for the roll-up doors, the replacement garages replicated the appearance of the former structures.

a. Forklift carrying a B-25 box loaded with contaminated soil out through the driveway at 110 E. Stewart. The driver made a left turn on E. Stewart and drove the box around the block to the OSF where it was processed for shipment to the disposal area. March, 1989.

b. Example of damage to the driveways caused by the forklift transporting rad-waste boxes. March, 1989.

c. New driveway under construction at 112 E. Stev
thick. Four inches of concrete, reinforced with wir
ment garages, which replicated those that were de
background. June, 1989.

Fig. 9:3 - Replacement Driveway Construction
Damage to private property outside the remediatio
tion on the E. Stewart properties, the Contractor h
and 112 E. Stewart Ave., and then drive them arou
The residential driveways were not constructed to
tons. They were badly damaged, requiring the con

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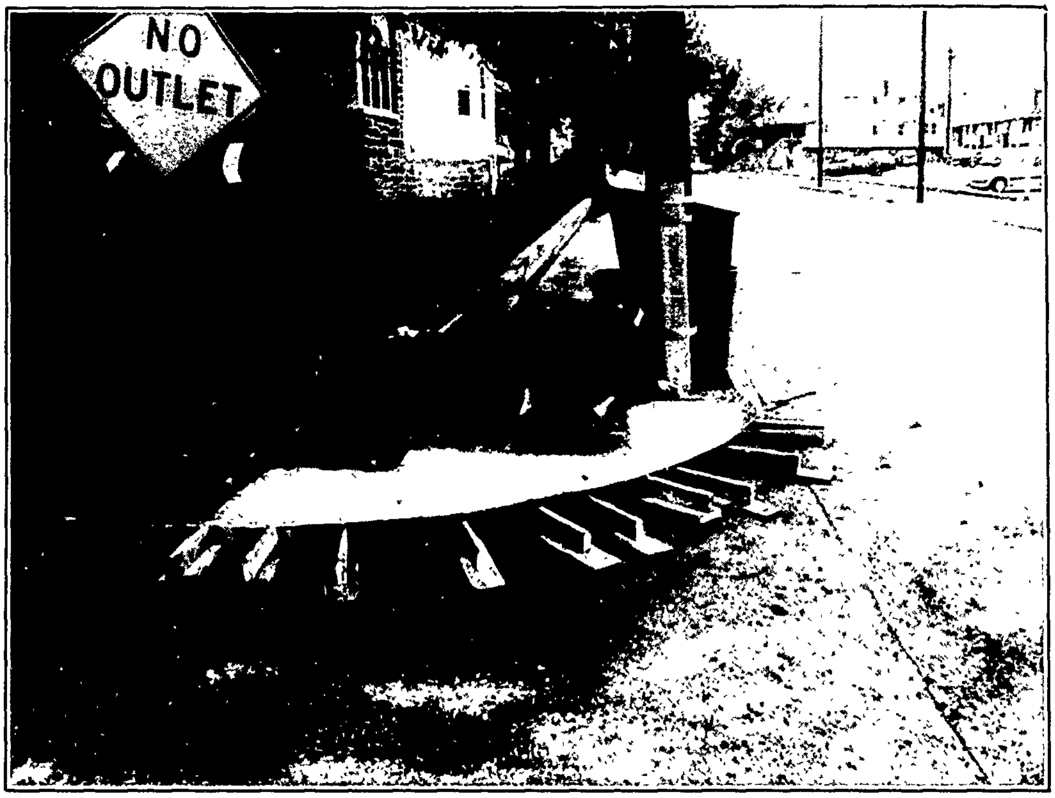
c. New driveway under construction at 112 E. Stewart. The basecourse seen in this photo is 4-inches thick. Four inches of concrete, reinforced with wire mesh, were poured over the basecourse. The replacement garages, which replicated those that were demolished, can be seen under construction in the background. June, 1989.

Fig. 9:3 - Replacement Driveway Construction
Damage to private property outside the remediation area was sometimes unavoidable. During soil excavation on the E. Stewart properties, the Contractor had to bring the boxes out through the driveways at 110 and 112 E. Stewart Ave., and then drive them around the block to the truck-loading area beside the OSF. The residential driveways were not constructed to support a forklift carrying boxes that weighed around 5 tons. They were badly damaged, requiring the construction of new driveways for the owners.

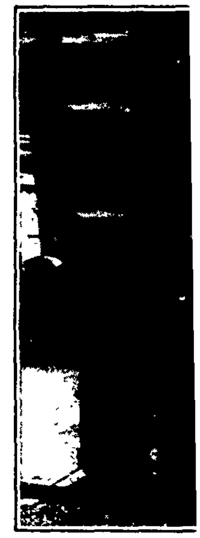
Fig. 9:4 - Jobsite in July, 1989, After Restoration
In accordance with contract specifications, the property was left as a grassed lot. The contour of the restored lot was modified so that approximately half the precipitation falling on it would drain in the direction toward the viewer in the photograph, and the other half would drain in the opposite direction. Compare Fig. 9:4 with Figs. 6:1 and 6:2, which were taken from the same perspective in August and December, 1988.

d lot. The contour of the restored lot
drain in the direction toward the viewer
Compare Fig. 9:4 with Figs. 6:1 and 6:2,

Fig. 9:5 - Miscellaneous Site Restoration Activities.



a. Repair to the curb at the corner of E. Stratford and Union Avenues. The curb was broken when it was rolled over by a truck hauling away rad-waste. This was held to be avoidable damage, so payment for the repairs was not made out of contract funds.



b. Preparing hazar
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held to be RCRA h
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at a site for toxic c
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disposal facility. T
the non-radioactive
disposed of as haz
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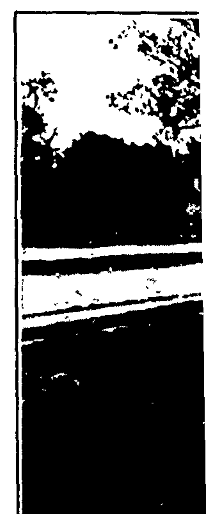

c. The stretch of E.
new bituminous su
Contractor elected

Union Avenues. The curb was broken when it was
as held to be avoidable damage, so payment for the

b. Preparing hazardous waste for shipment. The 105 basement contained numerous containers of paint and household chemicals which were held to be RCRA hazardous waste because the residence once contained a commercial enterprise. The containers and the contents posed a special disposal problem. Since the outside of the containers had unremovable radioactive contamination, they could not be disposed of at a site for toxic chemical waste, and the chemical contents of the containers prevented them from being disposed of at a rad-waste disposal facility. To solve the problem, the containers were emptied and the non-radioactive contents mixed in 5-gallon buckets which could be disposed of as hazardous waste. The empty radioactive containers were then disposed of as rad-waste.

c. The stretch of E. Stratford Ave. that ran through the jobsite received a new bituminous surface. This was not a contract requirement. The Contractor elected to do it at his own expense.

CHAPTER 10

PROJECT MANAGEMENT

10.0

PROJECT MANAGEMENT

10.1 Scope.

This chapter explains the field operations involving day-to-day Quality Assurance of the Contractor's work, with responsibilities of the onsite Project Engineer emphasized to serve as possible guidelines for the Corps of Engineers' field oversight role on future projects. Also discussed is the implementation of the various contract modifications and the reasons why they were necessary.

10.2 Responsibilities of the Project Engineer.

The onsite Project Engineer was a GS-12 Civil Engineer. His responsibilities were:

(1) Making day-to-day Q/A inspections of the Contractor's workmanship to assure a quality product. Ensuring that the Contractor's Q/C and Safety staff were performing as specified.

(2) Keeping track of project costs. Informing upper-level management of anticipated cost overruns within enough time to allow them to take corrective action. Checking all Contractor requisitions for payment to ensure correctness.

(3) Keeping a written daily record of the work performed and preparing a photographic documentary of such. Assuring that upper-level management was kept informed about the status of the project. Deferring to upper-level management on especially serious problems or controversial matters that could not be resolved in the field. Documenting such issues, either in the Daily Report or in a memo to higher authority.

(4) Responding in a timely fashion to requests from upper-level management for the preparation of any documents or information from the field.

(5) Utilizing the onsite services of Argonne National Laboratories for Quality Assurance in matters of radiation detection, identification and control; performing quality assurance checks on the Contractor's radiation survey and analytical activities.

(6) Certifying all contaminated waste shipments leaving the jobsite.

Personally weighing and inspecting all containers of contaminated waste destined for shipment. Assuring that the scale used to weigh containers was properly calibrated. Checking all waste-shipment manifests to ensure that the identity and concentration of contaminants stated thereon was correct. Signing all waste-shipment manifests.

(7) Acquiring a working understanding early on in the job of the analytical methods and equipment used by hired consultants to identify and quantify contaminants unique to the remediation effort underway. Being able to interface satisfactorily with chemists, industrial hygienists, health physicists, or whatever other technical support personnel were required to prosecute the work. Knowing when to stop work on an area that had attained release criteria.

(8) Interfacing with the Contractor. Resolving day-to-day disagreements with the Contractor. Participating in the negotiation of fair and reasonable prices on contract changes. Establishing all necessary documentation to support the Government's negotiating position.

(9) Coordinating and/or reviewing/approving the technical submittals.

10.3 Upper-Level Management.

Contract administration and weekly supervision and inspection were performed by the Northeast Resident Office in Tobyhanna, Pennsylvania, under the direction of a GS-13 supervisory civil engineer. Approval of contract changes of up to $50,000 were made by a GS-14 civil engineer in charge of the Harrisburg Area Office, in Harrisburg, Pennsylvania. Contract changes costing more than $50,000 had to be approved by the Contracting Officer in Baltimore.

10.4 Operations.

Covered under this title is a discussion of inspections, meetings, preparation of Quality Assurance Reports, and processing of payment requisitions.

10.4.1 Inspections.

Inspections of the Contractor's Q/C system during the course of work were of three types: Preparatory, Initial, and Follow-Up.

10.4.1.1 Preparatory Inspections.

Preparatory Inspections went hand-in-hand with the Contractor's submittal of the Phase Hazard Analysis. On the PHA, the Contractor set forth the details of his plan for attacking the phase of work. This plan had much to do with what type of radiological and nonradiological hazards that would by faced, and hence the type of personnel protection that would be required. The Contractor's Q/C, Safety and Management Staff, and the Government Project Engineer, would then verify that all safety equipment, and all tools and mechanical equipment, that the PHA stated would be used, were available and functional, and that all workers involved in the phase of work had read and signed the PHA and knew what they were supposed to do. That verification constituted the Preparatory Inspection. The PHA was then signed by all parties, thus providing the documentation that the Preparatory Inspection had been performed, and that everything was in order.

10.4.1.2 Initial and Follow-up Inspections.

Once a phase of work was underway, the Contractor's performance was continually inspected (least once daily) by his Q/C system, and by the Government's Project Engineer, and by Argonne National Laboratory. This was to ensure that the Contractor was making progress, and also to determine if all provisions of the PHA and the Corps of Engineer's Safety Manual were being adhered to. In cases where it turned out that any provisions of the PHA were unnecessary or were not achieving the desired result, those provisions were deleted or substituted by other provisions in an addendum to the PHA. The daily inspection which took place on the first day of work following the Project Engineer's approval of the PHA was termed the "initial inspection." All daily inspections which took place on succeeding days of work were termed "follow-up" inspections.

10.4.2 Daily Report of Quality Assurance.

The findings of the Project Engineer's initial and follow-up inspections were written up in his Daily Report of Quality Assurance (ENG FORM 2538, Feb 85). This report also gave a brief account of the separate work activities performed by each of the project subcontractors. Coupled with the Contractor's Q/C Report, it also became a daily record of work progress. Space was provided on ENG FORM 2538 to address other subjects such as Safety, Verbal Instructions Given to the Contractor, Controversial Matters, etc. With regard to controversial matters, these were usually expounded upon by the Project Engineer in a special memo to the Resident Engineer in Tobyhanna, Pa.

10.4.3 Meetings.

Regularly scheduled meetings were of three types: 1) Weekly Progress Meetings, 2) Monthly Safety Meetings, and 3) Tool Box Safety Discussions. Holding these meetings was a contract requirement, set forth in the provisions of the RFP, so the Contractor's Project Manager chaired the meetings and wrote up the minutes.

10.4.3.1 Weekly Progress Meetings.

These were normally held at 0900 hours, every Wednesday morning. Regular attendees were the COR or somebody representing him from the Northeast Resident Office, the Project Engineer, the EPA Proj. Manager, the Argonne Health Physicist, and the Contractor's staff-- consisting of the Project Manager, the Site Health Physicist, the Site Health & Safety Officer, and the Q/C Representative. The chief purpose of the Weekly Progress Meeting was to bring the COR and the EPA Project Manager up to date on what was going on.

The Weekly Progress Meeting was formal and adhered to an established agenda. It began with review and approval of the minutes from the previous week's meeting, followed by a review of work progress since the last meeting, followed by a discussion of general topics, followed by a presentation of projected work activities over the coming two weeks. The meeting was concluded by a motion to adjourn. Minutes of these meetings are contained in the Project Files, maintained by the Construction Division, Baltimore District, Corps of Engineers.

10.4.3.2 Monthly Safety Meetings.

These were usually held the last working day of the month. Regular attendees were the Project Engineer, the ANL Health Physicist, and the CNSI onsite staff, consisting of the Project Manager, the Site Health Physicist, and the Site Health and Safety Officer. The purposes were: 1) to review the safety record for the month ending, 2) identify any potential safety hazards not foreseen in the PHA and conclude what measures might be implemented to prevent such hazards from causing accidents, 3) to report on the level of personnel radiation exposure for the month preceding, based on urinalysis and dosimetry results.

10.4.3.3 Weekly Tool Box Safety Discussions.

These were held at 0630 hours on the last working day of the week. They were attended by all jobsite personnel. The Site Health & Safety Officer would address the workers about any developing concerns for safety he may have had,

and then the floor was open to questions and discussion, so that anyone could bring up a safety concern they may have had. This feedback from the workers was quite useful in identifying potential hazards and implementing safety controls before the hazards caused accidents.

10.4.4 Monthly Progress Payments.

During the first seven months of the job, the Contractor and the Project Engineer used different methods to keep track of the quantity of radioactive waste removal that the Contractor was eligible to be paid for on monthly progress payments. Problems repeatedly arose during this period because the quantities of the Contractor and the Project Engineer were not in agreement. This resulted in the Resident Engineer, in Tobyhanna, Pennsylvania, issuing a directive to the Contractor to start using the Project Engineer's method, beginning with his payment requisition for March 1989. This the Contractor did, with the modification of processing it by computer. The Project Engineer would then check the Contractor's computerized version by hand solution. Following the Contractor's adoption of the Project Engineer's "Payment Analysis Method", claims for overpayment or underpayment on progress payment requisitions ceased.

10.4.4.1 "Payment Analysis Method".

The "Payment Analysis Method" is one of the important innovations to come out of the Lansdowne project that is useful where the principal items for payment involve the disposal of quantities of contaminated materials. An example of a "Payment Analysis" for the month of February 1989 appears in Appendix G. It was prepared by the Project Engineer for the Contractor, after the Contractor had understated the quantity of rubble he was entitled to be paid for by $7,454.

The "Payment Analysis Method" requires the Contractor to list all quantities for payment by rad-waste shipment number. Space is provided next to the Contractor's stated quantities for the Project Engineer to enter the quantities from the personal record he keeps. Any source of error between the Contractor's and Project Engineer's total tallys can thereby be quickly located.

Another cause of difficulties was a provision in the contract that permitted the Contractor to bill for rad-waste shipments that had not yet been received by Envirocare at 33% of their value and collect the remaining 67% on the following month's payment requisition. The Contractor sometimes forgot that he had already received partial payment for a shipment and either billed the Government for the full amount or did not bill for the remaining 67% due him. This resulted in overcharges as high as $90,000 and shortfalls as high as $70,000. The "Payment Analysis Method" resolved the problem by considering that the Contractor was being paid for one-third of the <u>quantities</u> of soil or

rubble that had been shipped but not yet received at the disposal facility. Payment for the remaining two-thirds of these quantities was made on the following month's progress payment. The purpose of this was to make all payments at the 100% rate or not at all. This avoided the errors and confusion that resulted when progress payments for soil and rubble had to be made at three different rates--i.e., 100%, 67%, and 33%.

10.5 Contract Modifications.

Contract changes numbered 12 in all, and they had the effect of approximately doubling the total contract amount from $4.9million to $11.4 million. The procedure by which the contract was modified was for the COR to formally request from the Contractor a proposal for performing out of scope work. After review of the Contractor's proposal, the COR would forward it to the Area Engineer in Harrisburg with a recommendation for approval or disapproval, in cases where the dollar amount of the change fell within the Area Engineer's purview for apporoval. If the amount of the change exceeded $50,000, it would be forwarded through the Area Engineer to the Contracting Officer in Baltimore. Prior to the implementation of Contractor proposals as formal contract modifications, they were referred to as "changes", and identified by a lettering system. Chronologically, the first proposal for contract modification to be submitted was designated as Change "AA". Change "AB" was the second, and so on. The 12 Contractor proposals for contract modification, Changes "AA" thru "AL" are sumarily discussed below. Additional information on these changes can be found in the Contract Files.

10.5.1 Change "AA".

The Contract with CNSI was a service contract, and as such, the Contractor was required to pay his classes of service employees an hourly wage at least equal to that determined by the U.S. Department of Labor, under the Service Contract Act, for the region of Philadelphia, Pennsylvania. However, the only Register of Wage Determinations prepared by the Department of Labor and used in the RFP was for classes of service employees employed on contracts for demolition services--i.e., equipment operators, laborers, and truck drivers. But the Contractor also employed security guards, emergency medical technicians, and radiation control technicians, who were not on the Register of Wage Determinations provided in the RFP, as the correct service contract clause had been inadvertently omitted from the Contract Clauses.

Change "AA" was intended to establish a wage rate for those employees not on the Register, if it could be concluded that the Contractor was paying them a lower wage than what employees in comparable professions would be receiving under the Service Contract Act. Pursuant to that end, the Contractor was asked to submit SF 1444's (Request for Authorization of Additional Classification and Rate) on the affected employees. After review of the SF 1444's by District Counsel, it was determined that the wages the Contractor was paying to security guards, emergency medical technicians, and radiation control technicians were

at least equal to wages due comparable classes of service workers under the Service Contract Act. Furthermore, review also showed that the Service Contract Act was included via other contract provisions. Change "AA", therefore, was never implemented as a formal contract change.

10.5.2 Change "AB".

Change "AB" was a solicitated proposal to construct a temporary asphalt driveway for the resident of 112 E. Stratford Avenue, when access to her existing driveway on Stratford Ave. became blocked by the Contractor's security fence. A temporary driveway was constructed on the Maple Avenue side of the property; the driveway was removed and the area restored to its original condition at the conclusion of the job. Change "AB" was implemented as the first contract modification, A-00001, on 8 Sept. 1988. It increased the total contract amount by $2,566.

10.5.3 Change "AC".

Change "AC" was the most costly and complicated of the Contractor's proposals for contract modification. It was the third proposed change to be submitted. and was handled as a two-part change order to pay for the overrun in contaminated soil. Part I provided for an interim unit price established by the Government until a negotiated unit price could be established through the issuance of Part II. The final price adjustment for both parts was $3,959,618.

The reason for the change was that a 300% overrun in contaminated soil and a 75% overrun in contaminated rubble were encountered. These large additions obviously impacted on the time of contract performance and far exceeded the plus or minus 15% threshold which is associated with a unit-price contract estimated-quantity. Accordingly, when the Government saw that the original estimated quantity would be exceeded, they sought to reduce the bid unit price for all quantities in excess of 115%. Negotiations began immediately but were complicated by the uncertainty of what the ultimate overrun quantity would be; how much additional time would be required (including the cost of extended overhead); and by the procedural requirements of obtaining certified cost and pricing data, and audit, for a change of this magnitude.

In order to pay the Contractor for the contaminated soil he was removing in excess of the originally estimated contract quantity while the extended overhead and other time and quantity dependent amounts were determined, audits were being performed, etc., the Government and CNSI negotiated an interim, revised (i.e., reduced) unit price. Negotiation under Part II reduced this unit price still further, provided reimbursement for extended overhead, and also extractd a lump sum credit for disposal-cost services which CNSI realized on the additional quantity of contaminated soil and rubble.

10.5.4 Change "AD".

Change "AD" was a proposal for the removal of a maple tree and a walnut tree growing in radioactive soil on the adjacent property of Mrs. Flora Beemer at 99 E. Stratford Avenue, and the removal of a large sycamore tree (3-foot diameter, 60 feet high) growing in similarly contaminated soil on the adjacent property of John Townsende at 112 E. Stewart Avenue.

The Contractor submitted his proposal for Change "AD" on 5 January 1989. Change "AD" was incorporated into the contract under Modification A-00003, along with Changes "AE" and "AF", on 1 March 89. Change "AD" increased the contract amount by $3,149.

10.5.5 Change "AE".

Change "AE" was a proposal to reimburse the Contractor for the 3000 feet of electrical conduit, 500 penetrometer points, and miscellaneous safety equipment which he furnished in support of the Second Argonne Subsurface Investigation. The total cost of these materials amounted to $7,073. Modification A-00003 committed the necessary funds for payment.

10.5.6 Change "AF".

There was no requirement in the Service Contract RFP for the Contractor to prepare an as-excavated topographic map of the area where contaminated soil was removed. Change "AF" was a Contractor proposal to provide one. The Contractor obtained a quote from his consulting engineers, Catania Engineering Associates, to do the work. Funds in the amount of $2,182 to make the payment were committed via Modification A-00003. Preparation of the topo map actually cost $1,797 more, since at the time Change "AF" was negotiated, the excavation area had not yet expanded to its final limits. Payment for the additional $1,797 was added to Change "AC" (Part 2).

10.5.7 Change "AG".

When Change "AG" was implemented as Modification A-0004, it compensated the Contractor $2,488 for the purchase and installation of the crushed stone and filter fabric used to overcome the groundwater problem in the sewer excavation.

10.5.8 Change "AH".

Change "AH" was the Contractor proposal to properly dispose of the chemical waste removed from the 105 E. Stratford basement. The subsequent contract modification resulting therefrom was designated A-00005. The chemical waste contained both known and unknown items.

The final scope of work involved in the analysis, segregation, and disposal of the unknown chemicals could not be determined in advance of accomplishing the work, so Modification A-00005 had to be issued in two parts. Part 1 provided funds that covered the disposition of the known chemicals. Part 2, issued later, provided funds for the final settlement of the disposition of the unknown chemicals. Altogether, Change "AH" increased the total contract amount by $7,069.

10.5.9 Change "AI".

Following the removal of the garages during soil excavation, the Contractor solicited proposals from four local building sub-contractors to have the structures replaced in kind. The successful bidder was Unlimited Ceilings of Linwood, Pa. Modification A-00006, in the amount of $45,917, authorized the Contractor to proceed with the work.

10.5.10 Change "AJ".

Change "AJ" provided for the replacement of the driveways at 110 and 112 E. Stewart Ave. that the Contractor's operations disturbed during the additional soil excavation under Change "AC". It also provided $2,383 to replace the chain-link fence in back of the 105/107 E. Stratford lot. Change "AJ" was effected under Modification A-00007. which increased the total contract amount by $18,798.

10.5.11 Change "AK".

Change "AK" was never implemented as a contract modification. It was to have been the instrument for initiating curb replacement on Maple Avenue. The change was cancelled when it was determined that the Contractor's operations had not broken the curbs in question.

10.5.12 Change "AL".

Change "AL" was a proposal to replace the trees that had been cut down on adjacent properties when it became evident in the course of the job that the trees were in the way of contaminated soil removal. Because it was neither possible nor economical to replace all of these trees in kind (for size and species), the EPA negotiated with the property owners for the following: a holly and dogwood tree would replace Mrs Beemer's walnut and maple trees; four small yew trees would replace Mr. Townsende's giant sycamore. Cost of all replacement trees was $1,997, paid for under Contract Modification A-00008.

10.5.13 Change "AM".

Change "AM" resulted in Modification A-0009, which in turn paid for the construction of a brick barbecue in the backyard of 112 E. Stewart Avenue, to replace the one that was destroyed during soil excavation. Cost: $600.

CHAPTER 11

LESSONS LEARNED

11.0

LESSONS LEARNED

11.1 Purpose.

The Lansdowne Project was a well executed job. Nevertheless, in hindsight, there were some things that probably could have been done differently to have made the job run more smoothly still. This chapter of the report discusses some of the lessons learned on this prototype project.

11.2 LESSON ONE--"Permit the Contractor to mix radioactive soil with radioactive rubble for shipment to the disposal site".

The Contractor's disposal costs were based on volume. The contract's unit cost was based on weight. Therefore, it was in the Contractor's and the Government's best interest to maximize volume reduction. Two unit prices were given for contaminated material: one for rubble and one for soil. To further maximize volume reduction, future contracts should allow for mixing of different materials, with the proviso that the Contractor provide an acceptable method for certifying quantities of different materials (by weight) contained within each shipping container.

11.3 LESSON TWO--"Permit members of the Technical Evaluation Team to examine the bidder's Cost Proposals during RFP evaluation."

After the initial evaluation, the members of the Technical Evaluation Team should be given the opportunity to examine the cost proposal. The successful bidder (CNSI) had several bid qualifications contained within the cost proposal that were not recognized by the Cost Evaluation Team.

11.4 LESSON THREE--"Do not arbitrarily apply the 5 pCi/g release criteria to subsurface soil horizons on future radiation clean-ups."

The 5 pCi/g (above background) threshold was the result of an interpolation, as noted previously in Chapter 7, of EPA regulations established under the Uranium Mill Tailings Radiation Control Act (UMTRCA), and was conservatively selected because of the high probability of future soil disturbances and the high population density of the area. These conditions are specific to the Lansdowne Radiation Site. On future radiation projects, great care should

again be taken in the determinations of action levels, at the ROD and/or the project design stages, to assure that the action levels are commensurate with site specific conditions. Radiation sites that are removed from populated areas and where there is little liklihood of post-remediation soil disturbances may qualify for a higher action level, in light of the great expenses involved in remediation and disposal of radioactively contaminated materials.

11.5 LESSON FOUR--"Perform a subsurface investigation to estimate quantities of contaminated soil prior to site remediation."

The volume of contaminated soil which had to be excavated from the site was probably the major unknown in the project. As the project progressed, it became clear that the original estimate was too low. At that point, onsite Corps and EPA personnel worked with Argonne National Laboratory to obtain a better estimate. This was essential to get a handle on the additional funds required to remediate the site.

The technique used by Argonne was to drive over 300 1-inch diameter by 10-foot long tubes into the ground on a 10-foot by 10-foot grid over the entire site. By lowering a collimated gamma scintillation detector into each tube, Argonne personnel were able to reasonably predict the depth and breadth of contamination. Their predicted 4200 tons of contaminated soil was considerably closer to the actual quantity than the original estimate of 1000 tons. The actual weight of soil excavated was 4097 tons. Because it took only two men to drive 40 holes per day, the cost and speed of the initial screening method proved cost effective.

Despite this expedited survey method and EPA rapid funds-request turnaround, the project came within hours of "running out of money" to pay the Contractor for the overrun soil he was excavating. To avoid similar problems in the future, it would be prudent to use the Argonne subsurface investigation method during the design stage of remediation and/or require the Contractor to do a similar survey during the initial remediation phase (i.e., before mass digging and hauling commences).

11.6 LESSON FIVE--"Select appropriate site and media specific background radiation levels for establishing release criteria for rubble".

In the application of clean-up criteria, it is usually agreed that the criteria values are over and above the level of the contaminant which is found naturally in the environment (i.e., the background value).

When dealing with radioactive contamination, there is sometimes difficulty establishing the appropriate clean-up level above the naturally occurring background level in the case of rubble. The most desireable unit of

measurement for background radiation is an activity concentration expressed in terms of pCi/g of material, which in the case of soil is readily determined by gamma spectroscopy. In the case of rubble, an activity concentration in terms of pCi/g is not so readily determined by gamma spectroscopy, because the rubble must first be pulverized in order to be molded into the proper geometry for analysis. It is not practical to do that on projects which require the correct classification and disposition of great quantities of rubble within a reasonable period of time. For this reason and others explained in Section 6.3.1.1, the Minimum Detectable Activity (MDA) above background, determined by gamma survey instruments, was substituted for the pCi/g criteria, in the case of rubble generated by the remediation of the Lansdowne site.

When building materials are involved that are not indigenous to the site (i.e., granite and other stone), they may exhibit a gross gamma activity that is above the ambient background of the site, owing to the presence of naturally occurring radionuclides in the materials. It may be adviseable to select appropriate background values for each type of non-indigenous material.

Whatever release activity level may be established for rubble going to a sanitary landfill, it is imperative that bidders responding to a RFP solicitation include in their proposals a "letter of acceptance" from the landfill stating that it will accept rubble having the specified activity levels in the RFP. Unless the rubble is to be left on site, it does no good to specify a release criteria that the sanitary landfill is under no obligation to accept.

11.7 LESSON SIX--"In the contract, specify acceptable Uncertainty Levels for release criteria for soil."

Remediation criteria for soil are given as a single value (i.e., the 5 pCi/g above background for radium). However, this does not mean that uniformity in clean-up levels is assured when criteria are applied in the field. There can be considerable variability and still satisfy the "letter" of the criteria.

When a radioactive sample is analyzed, the relative counting error is determined primarily by (1) the efficiency (sensitivity) of the detector system, (2) the system background, and (3) the counting time. The uncertainty for any sample can be "selected" by controlling the counting time.

Consider the hypothetical example data in Table 11:1. In the Test A column, only Sample #3 would satisfy the 5 pCi/g criteria. (The numbers in parenthesis are the relative percent errors). However, if the same samples were re-analyzed in Test B with a lower uncertainty (lower relative percent error) we find that Samples 1 thru 4 now satisfy the release criteria. Both Test A and Test B are correct, but they were designed to provide different relative errors. The Test C in Table 11:1 is an example of unacceptable data because it does not list the uncertainty level, thereby depriving the project manager of the option to control the decision making process. High uncertainty can be expensive if the clean-up is near the criteria level.

TABLE 11:1 - ACCEPTABLE UNCERTAINTY

EXAMPLE OF
"ACCEPTABLE" UNCERTAINTY
(WITH SAME CONFIDENCE LEVEL)

SAMPLE NUMBER	CONCENTRATION (pCi^{226} Ra/g) TEST A	TEST B	TEST C
1	5 ± 3 (60)	4.5 ± 0.5 (11)	8 (?)
2	4 ± 2 (50)	4.2 ± 0.2 (5)	6 (?)
3	4 ± 1 (25)	3.5 ± 0.5 (14)	5 (?)
4	9 ± 5 (56)	4.8 ± 0.1 (2)	14 (?)
5	55 ± 10 (18)	60 ± 1 (2)	65 (?)
6	7 ± 5 (71)	6 ± 0.5 (8)	12 (?)
7	4 ± 2 (50)	5.5 ± 0.1	6 (?)

On the other hand, it is also a waste of time and resources to insist on low uncertainty when the concentration of radioniuclides is orders of magnitude above or below the release criteria.

At Lansdowne, the final Argonne Q/A soil verification data was below 10% for levels near the 5 pCi/g criteria, however, in order to ensure the most efficient use of funds, the required relative error for sample analysis should be specified in the remediation contract.

11.8 LESSON SEVEN--"Provide health-physics training to Corps of Engineers personnel."

If the Corps of Engineers is to become involved with radiation clean-ups on a recurrent basis, health physics training, such as the 200-hour Applied Health Physics course offered by Oak Ridge Laboratories (Appendix K), should be provided to project personnel.

11.9 LESSON EIGHT--"Equip field RADCON personnel with more discriminating gamma survey instruments."

During removal of contaminated soil from the Lansdowne site, field RADCON would make on-the-spot determinations about the concentration of any radium in the soil based on the number of counts per minute detected with a Ludlum Model 2220 scalar/ratemeter, equiped with a sodium-iodide gamma scintillation detector. This equipment did not segregate radium as the radionuclide responsible for the counts, and it is suspected that some of the counts may have been attributable to naturally occurring Potassium-40 (K-40), causing some quantities of soil to be misclassified as contaminated and ordered removed from the site. Although we suspect that this quantity was not significant at Lansdowne, that may not be the case on future jobs if the same type of gamma survey equipment is used. Recent advances in the design of portable survey instruments (e.g., Eberline ESP-2 and others) can identify specific radionuclides responsible for counts, and may make it possible to totally prevent any chance of misclassifying clean soil as rad-waste.

CHAPTER 12

CONCLUSIONS

CHAPTER 12

12.0

CONCLUSIONS

12.1 Project Success.

Lansdowne was the first radiation clean-up ever attempted by the U.S. Army Corps of Engineers. The success of the project demonstrates that the joint efforts of the Corps of Engineers, the EPA, Argonne National Laboratory and Chem-Nuclear Systems, Inc. (along with their subcontractors); working in a cooperative atmosphere with local and state officials, can produce a safe and timely clean-up.

All goals associated with the project were achieved. A potential radiation hazard to the community was removed to designated levels. Property that was once worthless or depressed in value can now provide tax revenue to the local government and/or be sold by its owners at fair market value.

12.2 Resolution No. 89-10 of the Lansdowne Borough Council.

On June 19, 1989, in recognition of the above achievements, the Council of the Borough of Lansdowne passed the following resolution:

"WHEREAS, the properties located at 105 and 107 East Stratford Avenue in the Borough of Lansdowne, Delaware County, Pennsylvania, were contaminated with radium and their by-products during the period between 1924 and 1945; and

WHEREAS, in 1964, authorities from the Commonwealth of Pennsylvania and the federal government conducted a clean-up of the properties in accordance with the standards at that time; and

WHEREAS, in 1984, the United States Environmental Protection Agency, Region III, conducted an investigation of the properties and determined that an unhealthful level of radium contamination existed; and

WHEREAS, in 1985, EPA included the properties on the National Priorities List and determined them to be eligible for clean-up under the "Superfund" program; and

WHEREAS, in August, 1988, EPA Region III began to dismantle the properties and remove contamination; and

WHEREAS, during the period of demolition those involved have consistently demonstrated a high level of professionalism and sensitivity to the concerns of the residents of Lansdowne; and

WHEREAS, as of June, 1989, the project essentially has been completed and the contamination successfully removed;

NOW, THEREFORE, we, the undersigned Council for the Borough of Lansdowne do hereby recognize the contribution made by EPA Region III, the Army Corps of Engineers and Chem-Nuclear Systems, Inc. to Lansdowne, and commend them for their professionalism throughout the project on the occasion of its successful completion."

a. Reporters interviewed neighborhood residents to obtain their views on the clean-up.

b. A crowd gathered to listen to short speeches by the di

d. Guests of honor removed the last barricade from E. Stratford Ave., opening the street once more to the public. Left to right: Robert Jones (Pa. Dept. of Environmental Resources), Victor Barnhart, (President, Chem-Nuclear Systems, Inc.), John Rankin (Mayor of Lansdowne), Curt Weldon (U.S. Representative of Congress), Edwin B. Erickson (EPA Region III Administrator), James P. Moore (Northeast Resident Engineer, U.S. Army Corps of Engineers).

e. The first automobile in 10 months drove down the newl street.

Fig. 12:1 - **Project Completion Cerem**
19 June 1989 was a festive day for th
residents around 105-107 E. Stratford
employees of the Government agenc
contractors who had participated in t
successful conclusion. The ceremon
Lansdowne Borough Council.

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b. A crowd gathered to listen to short speeches by the dignitaries.

c. Councilman George Bochansky read Council Re
acknowledging the contribution made by the EPA,
Engineers, and Chem-Nuclear Systems, Inc.

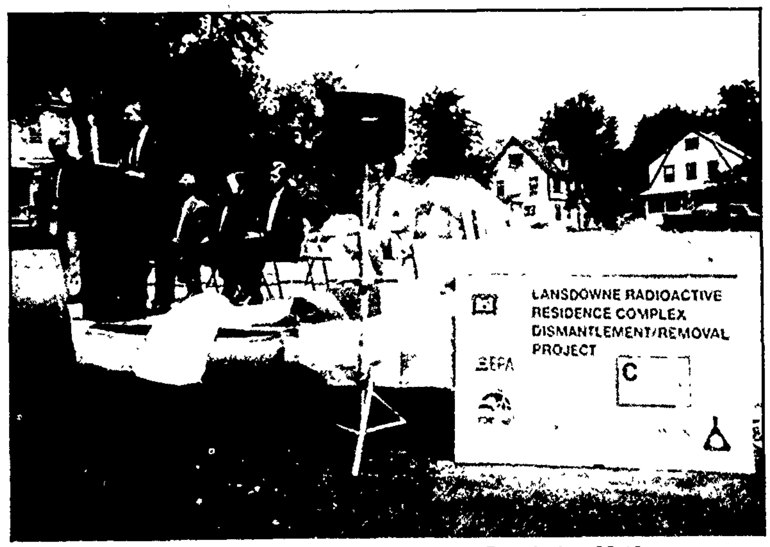
E. Stratford Ave., open-
Robert Jones (Pa.
(President, Chem-
lowne), Curt Weldon
(EPA Region III Ad-
gineer, U.S. Army

e. The first automobile in 10 months drove down the newly reopened street.

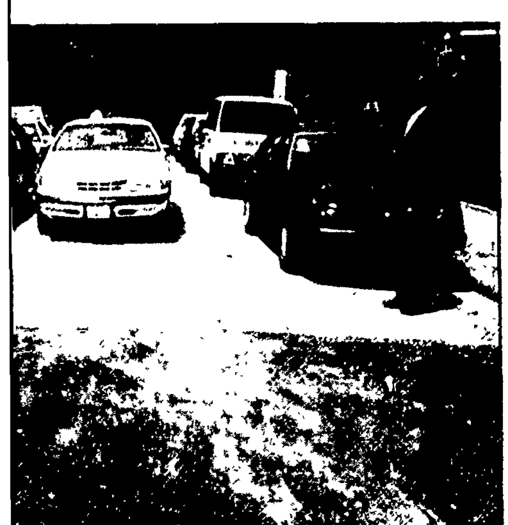
f. Project Managers were all smiles. Left to right: R.
Janosik (EPA), Walter Wickboldt (COE).

Fig. 12:1 - Project Completion Ceremony
19 June 1989 was a festive day for the neighborhood residents around 105-107 E. Stratford Ave., and also for the employees of the Government agencies, contractors and sub-contractors who had participated in bringing the project to a successful conclusion. The ceremony was sponsored by the Lansdowne Borough Council.

:en to short speeches by the dignitaries.



c. Councilman George Bochansky read Council Resolution 89-10, acknowledging the contribution made by the EPA, the U.S. Army Corps of Engineers, and Chem-Nuclear Systems, Inc.



'0 months drove down the newly reopened

f. Project Managers were all smiles. Left to right. Ray Huston (CNSI), Vic Janosik (EPA), Walter Wickboldt (COE).

13.0

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1. U.S. Army Corps of Engineers, Engineering Pamphlet 1110-2-6, para. 11(e)(10), 1987.

2. Argonne National Laboratories, Radiological Assessment Report for the Lansdowne Property, 105-107 East Stratford Avenue, Lansdowne, Pennsylvania, pp. 25-27, 1985.

3. U.S. Department of Health, Education and Welfare, Public Health Service, Decontamination Study of a Family Dwelling Formerly Used for Radium Processing, 1967.

4. Argonne National Laboratories, Remedial Action Plans and Procedures for the Lansdowne Property, 105-107 East Stratford Avenue, Lansdowne, Pennsylvania, p. 24, 1985.

5. Chem-Nuclear Systems, Inc., A Proposal to the U.S. Army Corps of Engineers for the Dismantlement and Disposal of the Lansdowne Radiation Site, Volume 1, para. 4.2.5, 1988.

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APPENDIX A

APPENDIX A

DESIGN ANALYSIS FOR FIRE-WALL BRACING DURING EXTERIOR BUILDING DISMANTLEMENT

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT

1. Reference: TM 5-809-1, Load Assumptions for Buildings, 28 March 86, H.Q. Dept. of Army.

2. Pertinent Data

Basic Wind Speed for Philadelphia, Pa: $V = 75$ mph (from Fig. 5-1)

Importance Factor: $I = 1.07$ (from Table 5-1)

Exposure Category: B—urban/surburban (para. 5.5 b.(2))

Height of top of wall above ground level: $z = 40$ ft.

Velocity Pressure Exposure Coefficient: $K_z = 0.23$ (from Table 5-2)

Gust Response Factor: $G_z = 1.46$ (from Table 5.3)

Free-standing wall height above brace: $h =$ (to be determined by analysis)

Free-standing wall length above brace: $L = 48$ ft.

Projected Area Normal to Wind: $A_f = (h)(L) = 48h$

Wall Thickness: $d = 0.67$ ft.

Ratio of wall height above brace to wall thickness: $h/d = h/0.67$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

3. <u>Calculation of Wind Velocity Pressure, q_z</u>

$q_z = 0.00256K_z(IV)^2$ (Equation 5-3)

$q_z = (0.00256)(0.23)[(1.07)(75)]^2$

$q_z = 3.79$ lbs/ft.^{2}

4. <u>Derivation of Formula for Wall Weight Calculation</u>

Wall Volume $= A_f(d)$

$= (48h)(0.67 \text{ ft.})$

$V_{wall} = 32.16h$

Unit Weight of brick with mortar $= \gamma_b = 125$ lbs/ft^3

Wall Weight $= W_w$

$= (V_{wall})(\gamma_b)$

$= (32.16h)(125 \text{ lbs/ft}^3)$

$= 4020h$ lbs.

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

5. Factor of Safety Analysis for Free-Standing Wall Height of 13 feet (no bracing).

a. Force Coefficient for h = 13.0 ft.

Ratio $h/d = 13.0/0.67$

$= 19.4$

$C_f = 1.8$ (from Table 5.7)

b. Wall Area for h = 13.0 ft.

$A_f = 48h$

$= (48)(13)$

$= 624 \text{ ft}^2$

c. Wind Force on Wall for h = 13.0 ft.

$F_w = (q_z)(G_z)(C_f)(A_f)$

$= (3.79 \text{ lbs/ft}^2)(1.46)(1.8)(624 \text{ ft}^2)$

$= 6215 \text{ lbs}$

d. Free-Standing Wall Weight for h = 13.0 ft.

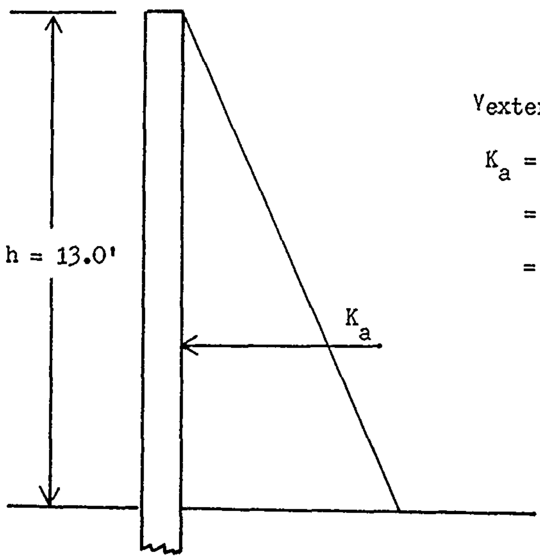
$W_w = 4020h$

$= (4020)(13.0)$

$= 52260 \text{ lbs}$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

e. <u>Force of Exterior Walls on Fire Wall, for h = 13.0 ft.</u>



$\gamma_{exterior} = 160 \text{ lbs/ft}^3$

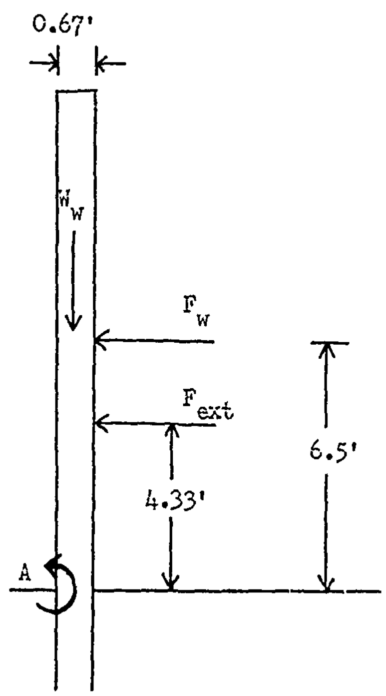
$$K_a = (\gamma_{ext})(h^2)/2$$
$$= (160)(13)^2/2$$
$$= 13{,}520 \text{ lbs/unit thickness}$$

Two 1.5'-thick exterior walls make contact with the free-standing fire wall. Total Force of the exterior walls on the firewall therefore is:

$$F_{ext} = 2(1.5 \text{ ft})(K_a)$$
$$= 2(1.5 \text{ ft})(13{,}520 \text{ lbs/ft})$$
$$= 40{,}560 \text{ lbs.}$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

f. Resisting and Toppling Moments about Point A for h = 13.0 ft.



Toppling Moments

$$M_T = F_w(6.5) + F_{ext}(4.33)$$
$$= (6215)(6.5) + (40,560)(4.33)$$
$$= 216,022 \text{ lbs·ft}$$

Resisting Moments

$$M_R = W_w(0.34)$$
$$= (52,260)(0.34)$$
$$= 17,507 \text{ lbs·ft}$$

g. Factor of Safety against Toppling for h = 13.0 ft.

$$FS = \Sigma M_R/\Sigma M_T$$
$$= 17,507/216,022$$
$$= 0.08$$

CONCLUDE THAT THE WALL WILL TOPPLE UNDER BASIC WIND SPEED UNLESS IT IS BRACED.

6. Factor of Safety Analysis for Free-Standing Wall Height of 5 feet above Bracing. $h = 5.0$ ft.

   a. Force Coefficient for $h = 5.0$ ft.

   Ratio $h/d = 5.0/0.67 = 7.4$

   $C_f = 1.4$ (from Table 5-7)

   b. Wall Area for $h = 5.0$ ft.

$$
\begin{aligned}
A_f &= 48h \\
&= 48(5) \\
&= 240 \text{ ft}^2
\end{aligned}
$$

   c. Wind Force on Wall for $h = 5.0$ ft.

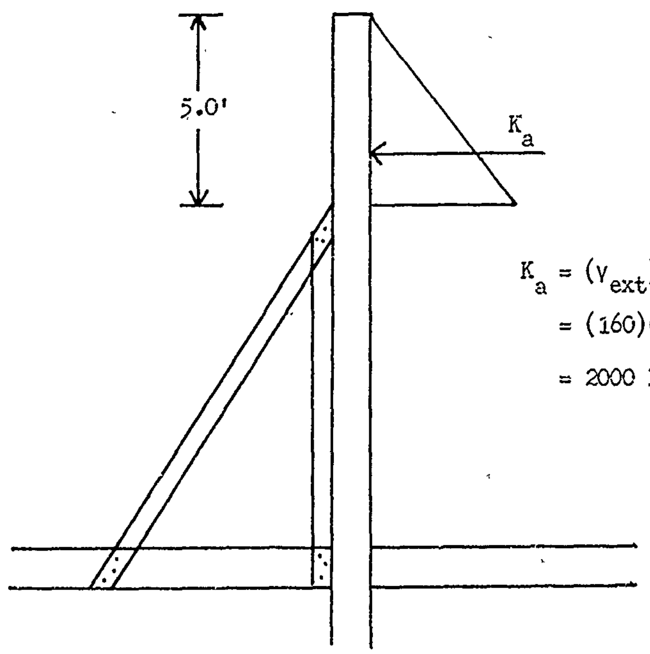
$$
\begin{aligned}
F_W &= (q_z)(G_z)(C_f)(A_f) \\
&= (3.79 \text{ lbs/ft}^2)(1.46)(1.4)(240 \text{ ft}^2) \\
&= 1859 \text{ lbs}
\end{aligned}
$$

   d. Free-Standing Wall Weight for $h = 5.0$ ft.

$$
\begin{aligned}
W_W &= 4020h \\
&= (4020)(5) \\
&= 20{,}100 \text{ lbs}
\end{aligned}
$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

e. Force of Exterior Walls on Fire Wall for h = 5.0 ft.



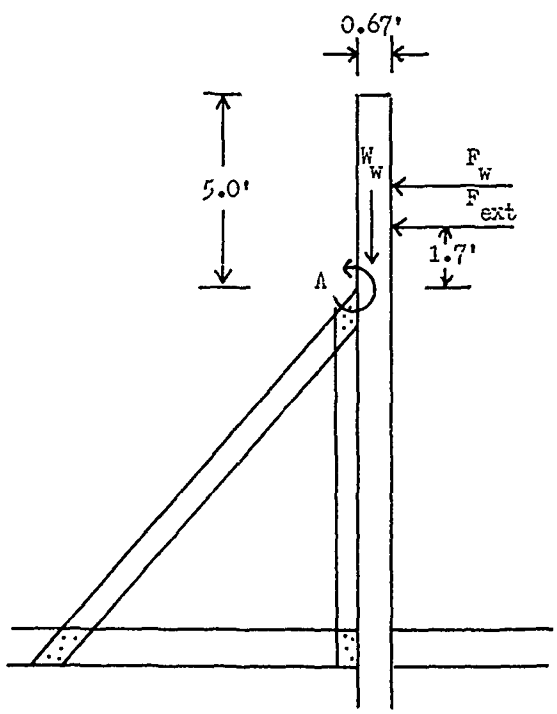
$$K_a = (\gamma_{ext})(h)^2/2$$
$$= (160)(5)^2/2$$
$$= 2000 \text{ lbs/unit thickness}$$

Two 1.5'-thick exterior stone walls make contact with the free-standing fire wall. Total force of the exterior walls on the firewall therefore is:

$$F_{ext} = 2(1.5 \text{ ft})(K_a)$$
$$= 2(1.5)(2000 \text{ lbs/ft})$$
$$= 6000 \text{ lbs.}$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

f. Resisting and Toppling Moments about Point A for h = 5.0 ft.



Toppling Moments

$$M_T = F_w(2.5') + F_{ext}(1.7')$$
$$= (1859)(2.5) + (6000)(1.7)$$
$$= 14{,}848 \text{ lbs}\cdot\text{ft}$$

Resisting Moments

$$M_R = W_w(0.34')$$
$$= 20{,}100 \text{ lbs}(0.34 \text{ ft})$$
$$= 6834 \text{ lbs}\cdot\text{ft}$$

g. Factor of Safety against Toppling for h = 5.0 ft.

$$FS = \Sigma M_R / \Sigma M_T$$
$$= 6834/14848$$
$$= 0.46$$

CONCLUDE THAT BRACING MUST BE HIGHER TO PREVENT FREE-STANDING PART OF WALL FROM TOPPLING UNDER BASIC WIND SPEED.

7. Factor of Safety Analysis for Free-Standing Wall Height of 1.5' above Bracing. h = 1.5 ft.

a. Force Coefficient for h = 1.5 ft.

Ratio h/d = 1.5/0.67 = 2.2

$C_f = 1.3$ (from Table 5-7)

b. Wall Area for h = 1.5 ft.

$$A_f = 48h$$
$$= 48(1.5)$$
$$= 72 \text{ ft}^2$$

c. Wind Force on Wall for h = 1.5 ft.

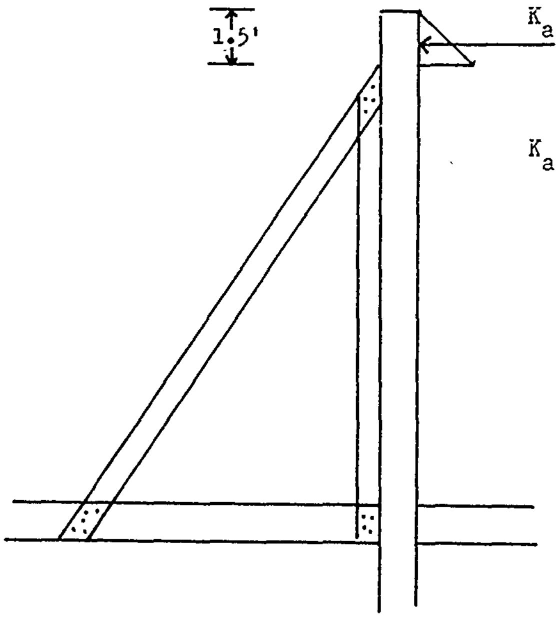
$$F_w = (q_z)(G_z)(C_f)(A_f)$$
$$= (3.79 \text{ lbs/ft}^2)(1.46)(1.3)(72 \text{ ft}^2)$$
$$= 518 \text{ lbs}$$

e. Free-Standing Wall Weight for h = 1.5 ft.

$$W_w = 4020h$$
$$= (4020)(1.5)$$
$$= 6030 \text{ lbs}$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

e. <u>Force of Exterior Walls on Fire Wall for h = 1.5 ft.</u>



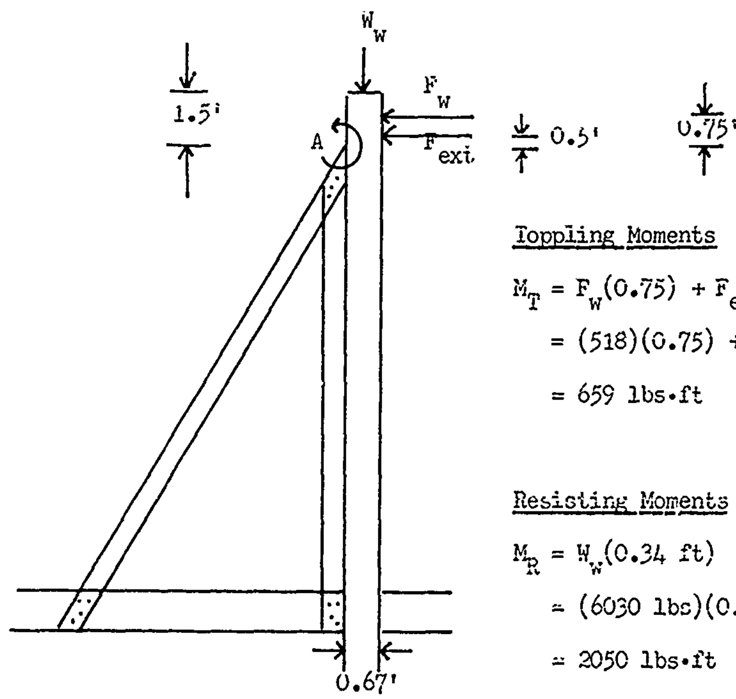
$$K_a = (\gamma_{ext})h^2$$
$$= (160)(1.5)^2$$
$$= 180 \text{ lbs/unit wall thickness}$$

Two 1.5'-thick exterior stone walls make contact with the free-standing fire wall. Total force of the exterior walls on the fire wall therefore is:

$$F_{ext} = 2(1.5)(K_a)$$
$$= 2(1.5)(180)$$
$$= 540 \text{ lbs}$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

f. Resisting and Toppling Moments about Point A for h = 1.5 ft.



Toppling Moments

$$M_T = F_w(0.75) + F_{ext}(0.5)$$
$$= (518)(0.75) + (540)(0.5)$$
$$= 659 \text{ lbs}\cdot\text{ft}$$

Resisting Moments

$$M_R = W_w(0.34 \text{ ft})$$
$$= (6030 \text{ lbs})(0.34 \text{ ft})$$
$$= 2050 \text{ lbs}\cdot\text{ft}$$

g. Factor of Safety Against Toppling for h = 1.5'.

$$FS = \Sigma M_R / \Sigma M_T$$
$$= 2050/659$$
$$= 3.1$$

CONCLUDE EXCESSIVE FACTOR OF SAFETY TO PREVENT WALL TOPPLING IN BASIC WIND SPEED. BRACING CAN BE LOWER.

8. Factor of Safety Analysis for Free-Standing Wall Height of 3.0 feet above Bracing. h = 3.0 ft.

a. Force Coefficient for h = 3.0 ft.

Ratio $h/d = 3.0/0.67 = 4.5$

$C_f = 1.35$ (from Table 5-7)

b. Wall Area for h = 3.0 ft.

$$A_f = 48h$$
$$= 48(3)$$
$$= 144 \text{ ft}^2$$

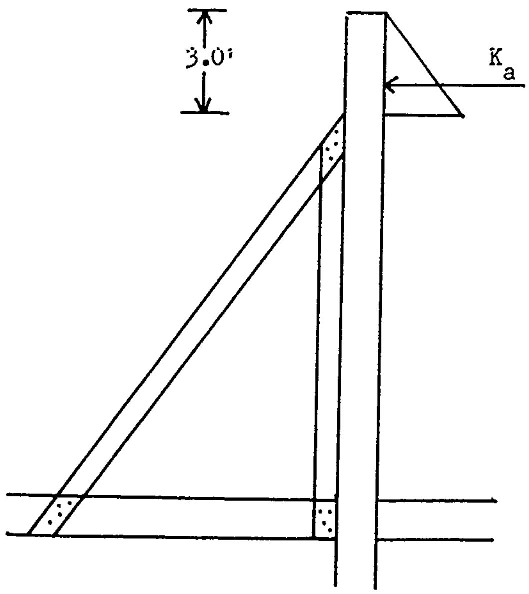
c. Wind Force on Wall for h = 3.0 ft.

$$F_W = (q_z)(G_z)(C_f)(A_f)$$
$$= (3.79 \text{ lbs/ft}^2)(1.46)(1.35)(144 \text{ ft}^2)$$
$$= 1076 \text{ lbs}$$

d. Free-Standing Wall Weight for h = 3.0 ft.

$$W_W = 4020h$$
$$= (4020)(3.5)$$
$$= 14{,}070 \text{ lbs}$$

e. Force of Exterior Walls on Fire Wall for h = 3.0 ft.



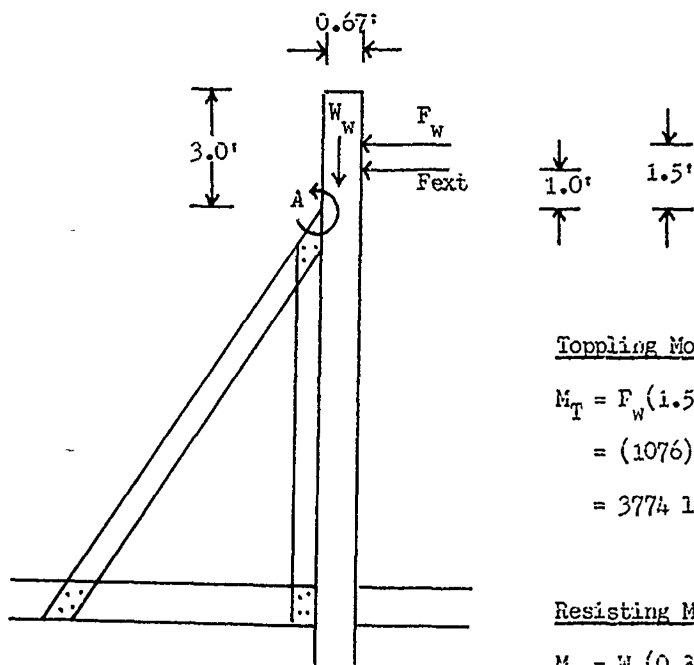
$$K_a = (\gamma_{ext})(h)^2/2$$
$$= (160)(3)^2/2$$
$$= 720 \text{ lbs/unit wall thickness}$$

Two 1.5'-thick exterior stone walls make contact with the free-standing fire wall. Total force of the exterior walls on the fire wall therefore is:

$$F_{ext} = 2(1.5 \text{ ft})(K_a)$$
$$= 2(1.5 \text{ ft})(720 \text{ lbs/ft})$$
$$= 2160 \text{ lbs}$$

FACTOR OF SAFETY ANALYSIS FOR FIRE-WALL SUPPORT
(Continued)

f. Resisting and Toppling Moments about Point A for h = 3.0 ft.



Toppling Moments

$M_T = F_w(1.5) + F_{ext}(1.0)$

$= (1076)(1.5) + (2160)(1.0)$

$= 3774$ lbs·ft

Resisting Moments

$M_R = W_w(0.34 \text{ ft})$

$= 14{,}070 \text{ lbs}(0.34 \text{ ft})$

$= 4784$ lbs·ft

g. Factor of Safety Against Toppling for h = 3.0 ft.

$FS = \Sigma M_R / \Sigma M_T$

$= 4784/3774$

$= 1.27$

SET BRACING 3.0 FEET BELOW TOP OF FIRE WALL

APPENDIX B

ARCHAEOLOGICAL ASSESSMENT OF RUINS DISCOVERED ON THE 110/112 E. STEWART AVENUE PROPERTIES

PRELIMINARY ARCHAEOLOGICAL ASSESSMENT OF
RUINS UNCOVERED DURING DISMANTLEMENT AND REMOVAL OF
THE LANSDOWNE RADIOACTIVE RESIDENCE COMPLEX
LANSDOWNE, PENNSYLVANIA

Prepared by

Stephen S. Israel
Planning Division

Prepared for
Engineering Division
Baltimore, Maryland

August 1989

ABSTRACT

A field visit was made to the project site on East Stratford Avenue to examine approximately 500 bottles excavated from an ash lens from within a buried stone foundation. The glass bottles appear to date to the first-quarter of the 20th century. The discarded ash, radium waste and bottles appear to be associated with the early phase of the production of radium, 1924-1930, prior to landscaping and development of the adjacent rear residential lots on Stewart Street. Beginning ca 1930 through 1944, the disposal of the radioactive ash and materials probably were no longer discarded in the rear yard. The stone foundation may be much earlier, unrelated, and potentially dates to the nearby mid-17th century Darby Creek Swedish settlement.

INTRODUCTION

The Corps of Engineers, Baltimore District in cooperation with U.S. Environmental Protection Agency is engaged in the removal of contaminated radium materials in Lansdowne, Pennsylvania, from a private residence and lot. Corps of Engineers Field Engineer, Mr. Walt Wickboldt upon exposing and excavating approximately 500 bottles from within a buried stone foundation and other small pockets of ash, in mid-April 1989, requested that the District archaeologist visit the project site to identify the bottles and their archaeological context. Mr. Israel, archaeologist at the Baltimore District made a field visit to the project site, April 24, 1989. The following is a summary of Mr. Israel's findings.

BACKGROUND

Dr. Hadjy Kabakjian, physicist, came to Philadelphia to teach physics at the University of Pennsylvania ca 1919 and settled with his family in Lansdowne, Pennsylvania a western Philadelphia suburb in 1924. The family rented or bought a frame duplex on East Stratford Avenue in Lansdowne. Starting in 1924, Kabakhjian began to process active radium for a multiple of purposes and continued to produce the radium until 1944. Kabakjian was regarded as a pioneer in the processing the rare and precious radium metal. In the process of producing the radium, Kabakjian disposed of the waste material in such a way that he contaminated a large portion of his yard and home with burned radioactive ash waste.

Mr. Wickboldt has been at the project site since August 1988, when work began on the identification and removal of radioactive waste that had

migrated through the soil and structures. The removal of the contaminated radioactive ash waste involved the dismantling of the frame-duplex house built ca 1910 and sheds in the back yard, and the removal of a large portion of the soil from the site. In the process of removing a car garage in an adjacent lot to the rear, dating to the 1930's, radioactive ash waste was detected in the soils below the garage. In excavating beneath the garage, a buried stone foundation was exposed containing reactive white ash lenses, historic ceramics, metal objects, and whole glass bottles. Only the bottles had been saved from an interest and historic perspective. When the archaeologist arrived onto the site, the bottles had been placed on plastic tarps on the ground. Most of the bottles were photographed in place on the tarps and appeared to date to the first-quarter of the 20th century. A more detail analysis of the bottles would be undertaken at a later date. The relationship between the early 20th century glass bottles and the stone foundation was at first inconclusive. The glass bottles were recovered from in and around 'the room' (Walt Wickboldt, Memo, 25 April 1989).

Literature search indicated that the 100 block of East Stratford Avenue was developed in the first decade of the 20th century with lots being built on, over a 40 year period. Dr. Kabakjian had either rented or purchased the frame-duplex at 105-107 East Stratford Avenue in 1924 and immediately began processing radium for a 20 year period until his death in 1944. Newspaper accounts indicate that his wife and children assisted him in the manufacturing of the radium in the basement of their duplex home. The 14 foot square stone foundation "room" which was exposed in the adjacent rear lot provides clues to mid-17th century Swedish settlement. Carmen Weber (pc) archaeologist for the City of Philadelphia, related that the Swedish had settled in the nearby Darby Creek Valley, building a number of log structures on stone foundations (usually 14 foot squares) and on bed rock.

"The room was found to be filled to the rim with ashes from burnt coal. The ashes were contaminated with up to 50 pCi/g of Radium-226. Mixed with the ashes were bits of broken china and hundreds of classic, antique bottles from the 19th Century era. However, they are contaminated both inside and outside, so they may yet end up in the rad-waste bin."

"Another interesting angle of this discovery is finding out that the subsurface contamination on the Townsende and Gretzenberger properties is not contamination that migrated through the soil over the years from the 105-107 E. Stratford Ave. lot. Kabakjian obviously had to carry the contaminated ashes across his property line and dump them in the underground room. And this had to have gone on for years in order to fill up the room...That the room was contaminated from within and not from without as a result of the migration of the contaminants off the Kabakjian property is attested to by the fact that soil directly outside the walls of the room is clean."

Walt Wickboldt, Memo, 21 April 1989.

However, due to the circumstances of the radioactive radioactive ash and the mechanical removal of the ash-fill lens by a mechanical bucket down to bed rock inside of the stone structure, in April 1989, the potential for finding additional historical clues is probably low.

"The 'room' is clean and requires no further demolition or dismantlement."

Walt Wickboldt, Memo, 25 April 1989.

In addition, a large portion of the surrounding surface soils were raised an landscaped in the early 1930's as depicted in the mechanically dug trench profiles in the removal of the contaminated soils and placed in rad-waste bins. The buried surface soils to the south of the stone foundation have also been mechanically removed as part of the removal project and exposed a light tan sandy loam clay subsoil.

For logistic and safety reasons, the early 20th century glass bottles were disposed of prior to making an inventory.

CONCLUSION AND RECOMMENDATIONS

This report documents a complex series of historical occupations and events at the project site. Ceramics, metals, and glass bottles dating to the first-quarter of the 20th century were excavated from within a stone foundation which had been capped by landscaping in the 1930's. A connection between the glass bottles and the physicist, Kabakjian, is suspect in manufacturing radium in the early years and the dumping of radioactive ash in his rear yard and adjacent lots 1924 through 1930, before houses were built on these contiguous lots.

District personnel suggested that arrangements might be made to provide further assistance in the field on a as needed basis. The District decided to maintain a photographic record of all future archaeological and historic trash finds by the field staff for the record.

SOURCES

Delaware County Planning Department
1983 Report of the Findings of Delaware County Historic Resources Survey for Lansdowne Borough.

Flannery, J. Edwin, Editor
1968 Lansdowne 1893-1968 - 75th Anniversary.

Johnson, George C.
1908 Lansdowne Past and Present 1888 - 1908.

Lansdowne Directories: 1903, 1904 and 1914.

Meixner, Esther Chilstrom
1960 Swedish Landmarks in the Delaware Valley Chancellor Press, Inc., Bridgeport, PA

Philadelphia Inquirer Newspaper articles, on the action, are on file in the Project Office.

U.S. Department of Health, Education and Welfare
1967 Decontamination Study of a Family Dwelling Formally Used for Radium Processing, Public Health Service, Rockville, Maryland.

Stephen Israel, FONECON with Carmen Weber, dated 26 April 1989.

James Moore, Memo to Walt Wickbolt, dated 25 April 1989.

Walt Wickboldt, FONECON with Larry Lower, dated 21 April 1989.

Walt Wickboldt, Memo to J. Moore, dated 21 April 1989.

Walt Wickboldt, Memo to J. Moore, dated 25 April 1989.

Walt Wickboldt, Memo to J. Moore, dated 26 April 1989.

Walt Wickboldt, Memo to J. Moore, dated 29 April 1989.

Walt Wickboldt, Project Photo-Album.

1870 Atlas of Delaware County, Pennsylvania, showing the project site as part of Darby Road Station crossroads, page 63.

1902 Map of Lansdowne, Pennsylvania, showing street names.

APPENDIX C

WAIVERS AND SPECIAL DISPENSATIONS

BOROUGH OF LANSDOWNE

Lansdowne, Pa

BOROUGH HALL
12 EAST BALTIMORE AVENUE
LANSDOWNE, PENNSYLVANIA 19050-2287
623-7300

John J. Rankin, Jr.
Mayor

R. J. Robinson, 3rd
Manager and Secretary

Ray Houston
Chem Nuclear'?
220 Stoneridge Drive
Columbia, South Carolina 29210

Sept. 26, 1989

Dear Ray:

The Borough of Lansdowne has approved the construction of two gagages on East Stewart Ave. in the rear of 105-107 East Stratford Ave. two feet above the maximum of twelve feet.

Thomas Schindelman

Thomas Schindelman

Code Enforcement Officer
Borough of Lansdowne

APPENDIX D

RESULTS OF COMPACTION TESTING

SUMMARY OF FINAL COMPACTION TEST RESULTS (ASTM-D-698)

Location	Depth (ft.)	Max. Dry Density (pcf)	In-Place Dry Density (pcf)	Compaction (%)	Reference (page/no.)
Replacement Sewer Line	2.5	118.9	113.8	95.7	D-6/4
	2.0	118.9	114.6	96.3	D-6/5
	1.3	118.9	116.2	97.7	D-6/6
	0.7	118.9	116.9	98.3	D-7/7
	0.0	118.9	118.3	99.5	D-7/10
105/107 E. Stratford & Adjacent Properties	11.6	121.8	119.7	98.3	D-29/4
	10.5	121.8	114.6	95.0	D-30/7
	9.8	121.8	119.7	98.3	D-29/6
	8.8	121.8	120.0	98.5	D-31/6
	8.0	121.8	119.5	98.1	D-33/1
	7.8	121.8	120.1	98.6	D-31/5
	7.2	121.8	118.0	96.8	D-34/4
	6.8	121.8	119.0	97.7	D-33/3
	6.3	124.0	118.9	96.0	D-21/5
	5.8	124.0	121.9	98.3	D-22/7
	5.2	124.0	118.0	95.2	D-22/8
	4.8	124.0	116.6	94.0	D-22/9
	4.2	124.0	119.2	96.2	D-22/10
	3.8	124.0	122.0	98.3	D-22/11
	3.3	124.0	122.6	98.8	D-22/12
	2.5	124.0	124.0	100.0	D-24/1
	2.0	121.8	118.1	97.0	D-24/6
	1.5	121.8	120.1	98.6	D-25/12
	1.0	121.8	119.1	97.9	D-26/17

Location	Depth (ft.)	Max. Dry Density (pcf)	In-Place Dry Density (pcf)	Compaction (%)	Reference (page/no.)
105/107 E. Stratford & Adjacent Properties	0.5	121.8	119.7	98.3	D-27/19
	0.0	121.8	124.7	102.4	D-27/23
110 E. Stewart garage footing					
NW corner	3.0	121.8	120.0	98.4	D-36/8
SE corner	3.0	121.8	122.9	101.0	D-36/9
112 E. Stewart garage footing					
NW corner	3.0	121.8	120.9	99.1	D-36/6
SE corner	3.0	121.8	122.9	101.0	D-36/7

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

TESTED FOR: Carlucci Construction
401 Meadow Street
Cheswick, PA 15024

Attn: Mr. Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE: June 9, 1989

OUR REPORT NO: 423-80068-017

REMARKS:

On June 2, 1989, final compaction tests were conducted at the above project site.

All test areas were found to meet project specifications either when initially tested or after any necessary recompaction. All tests results were reviewed by the Corps. of Engineers inspector each day.

Enclosed are all soil inspection reports from this project.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

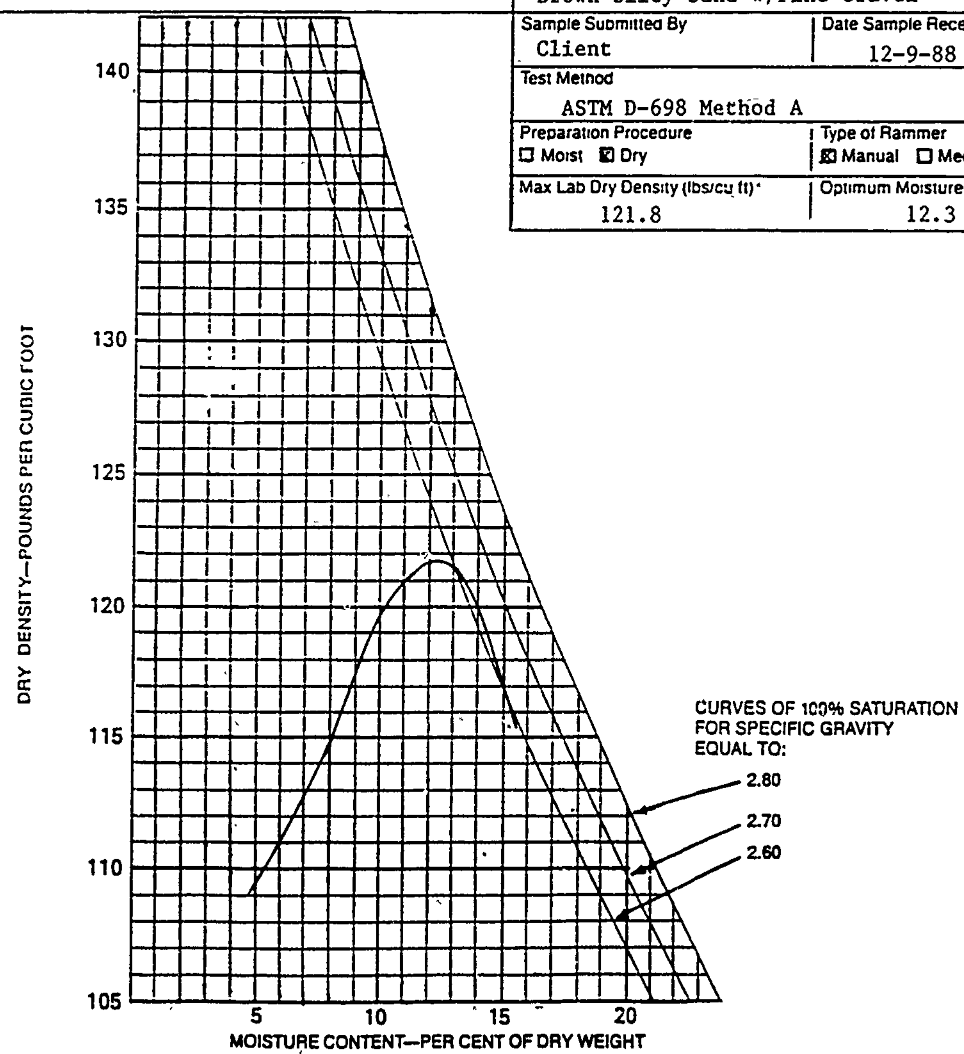
R. B. Lukens,
Division Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division
650 Elmwood Avenue
Sharon Hill, Pennsylvania 19079
215/237-6363

MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project: Lansdowne, PA	Report Date: 12-19-88	Report No.: 001	PTL-II Order No.: 423-80068
	Client Order No.: PSI 423-037	Page: 1 of 1	Lab No.: 881340
Client: Carlucci Construction, Box 189, Lansdowne, PA 19050	Source of Sample: Delivered by Client		
	Soil Description: Brown Silty Sand w/Fine Gravel		

Sample Submitted By: Client	Date Sample Received: 12-9-88
Test Method: ASTM D-698 Method A	
Preparation Procedure: ☐ Moist ☒ Dry	Type of Rammer: ☒ Manual ☐ Mechanical
Max Lab Dry Density (lbs/cu ft)*: 121.8	Optimum Moisture (%): 12.3



Distribution/Remarks: cc: 1-Client, Bill Seitz	Submitted By: PROFESSIONAL SERVICE IND., INC. R. B. Lukens, Division Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division
REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Landsdowne, PA

DATE 4/26/89

OUR REPORT NO.: 423-80068-002 Page 1 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	4/26/89	-2½'		118.9	12.8	107.5	90.5	1-B
2	4/26/89	-2½'		118.9	14.0	109.7	92.2	1-B
3	4/26/89	-2½'		118.9	12.3	111.5	93.7	Retest After Compaction 1-B
4	4/26/89	-2½'		118.9	12.0	113.8	95.7	Compacted again and Restested 1-C-A
5	4/26/89	-2'		118.9	10.9	114.6	96.3	1-A
6	4/26/89	-1' 4"		118.9	14.1	116.2	97.7	1-A

TEST LOCATION:

1	Sewer Line Center Lift # 1 East Stratford Ave.
2	Sewer Line Center Lift # 1 East Stratford Ave.
3	Sewer Line Center Lift # 1 East Stratford Ave.
4	Sewer Line Center Lift # 1 East Stratford Ave.
5	Sewer Line East Center Lift # 2 East Stratford Ave.
6	Sewer Line West End Lift # 3 East Stratford Ave.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: John Archibald

Respectfully submitted,
Professional Service Industries, Inc.

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne, PA 19050

R.B. Lukens, Div. Manager

PSI A-100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 4/26/89

OUR REPORT NO: 423-80068-002 Page 2 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	4/26/89	-8"		118.9	11.2	116.9	98.3	1-A
8	4/26/89	-8"		118.9	15.6	113.7	95.6	1-A
9	4/26/89	Final		118.9	15.0	116.2	97.7	1-A
10	4/26/89	Final		118.9	14.7	118.3	99.5	1-A

TEST LOCATION:

7	Sewer Line East End Lift # 4 East Stratford Ave.
8	Sewer Line West End Lift # 4 East Stratford Ave.
9	Sewer Line EAst Center Lift # 5 East Stratford Ave.
10	Sewer Line EAst Center Lift # 5 East Stratford Ave.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: John Archibald

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Manager

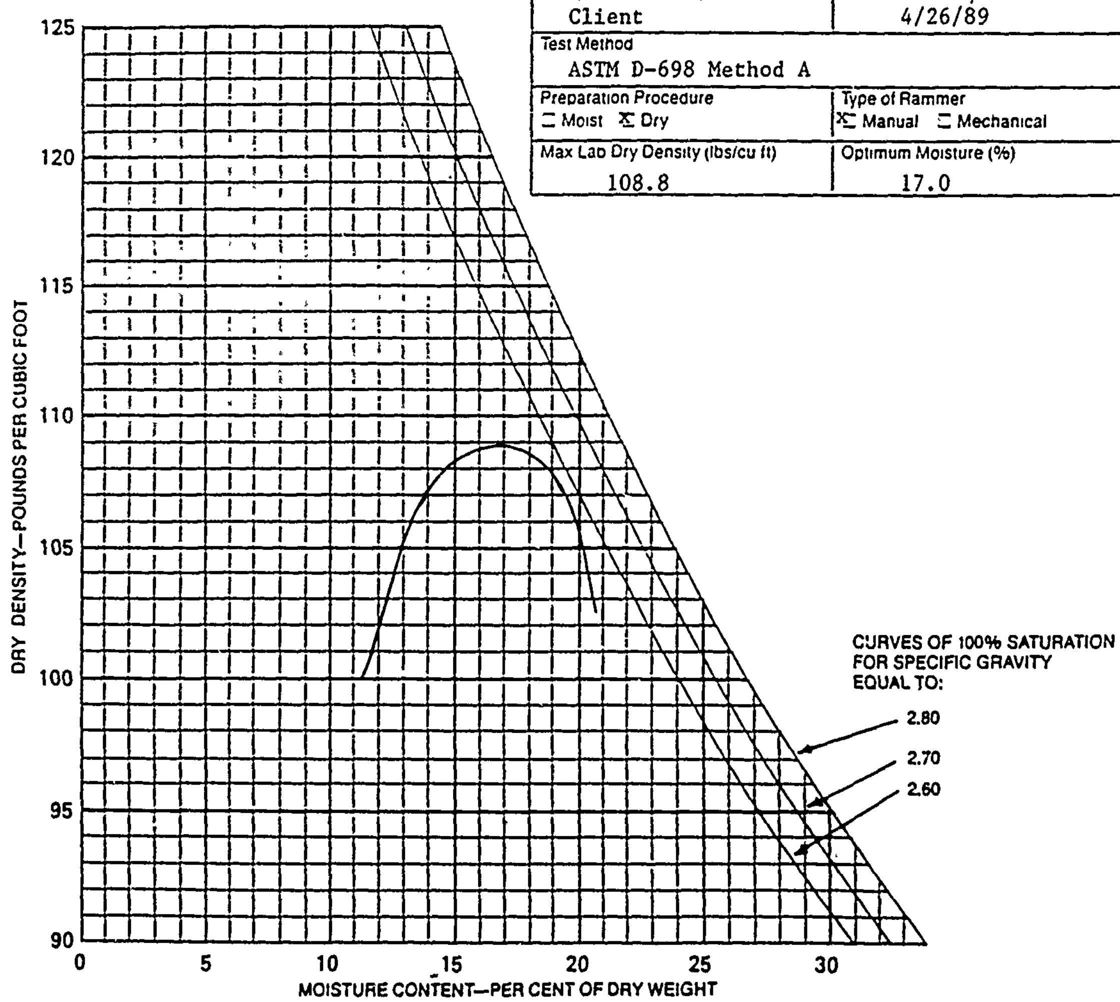
cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne, PA 19050

PSI A-100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project: Radioactive Residence Complex, Lansdowne, PA	Report Date: 4/28/89	Report No.: 003	PTL-II Order No.: 423-80068
	Client Order No.: PSI 423-037	Page: 1 of 1	Lab No.: 890368
Client: Carlucci Construction Co., Inc., Box 198, Lansdowne, PA 19050	Source of Sample: Site Material		
	Soil Description:		
	Sample Submitted By: Client	Date Sample Received: 4/26/89	
	Test Method: ASTM D-698 Method A		
	Preparation Procedure: ☐ Moist ☒ Dry	Type of Rammer: ☒ Manual ☐ Mechanical	
	Max Lab Dry Density (lbs/cu ft): 108.8	Optimum Moisture (%): 17.0	



Distribution/Remarks	Submitted By:
cc: 1-Client, Bill Seitz	PROFESSIONAL SERVICE IND. INC.
	R. B. Lukens, Division Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE: 5/9/89

OUR REPORT NO. 423-80068-004 Page 1 of 6

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/9/89	-32"		121.8	19.9	108.9	89.4	1-B
2		-48"		121.8	18.8	112.6	92.4	1-B
3		-8'8" 1st Lift		108.8	18.1	107.1	98.4	1-A
4		-45"		121.8	14.3	113.8	93.5	1-B
5		-36"		121.8	13.1	116.2	95.4	1-A
6		-44"		121.8	14.6	117.6	96.5	1-C-A

TEST LOCATION:

1	E. Sewer Trench
2	W. Sewer Trench
3	Haul Road - Center
4	W. Sewer Trench, S. End
5	W. Sewer Trench, N. End
6	W. Sewer Trench, S. End Retest No. 4

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:
Inspector: R. B Lukens

Minimum Compaction: 95%
Total Lifts: 13
1 Test/15,000 SF

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE: 5/9/89

OUR REPORT NO: 423-80068-004 Page 2 of 6

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	5/9/89	-24"		121.8	14.2	115.3	94.6	1-B
8		-8'8"		108.8	16.5	108.9	100.1	1-A
9		-24"		121.8	14.6	118.9	97.6	1-C-A
10		-37"		121.8	12.6	118.9	97.6	1-A
11		-17"		121.8	18.4	111.4	91.5	1-B
12		-8'8"		121.8	13.8	120.9	99.2	1-A

TEST LOCATION:

7	E. Sewer Trench
8	Haul Road-Center
9	E. Sewer Trench- Retest No. 7
10	W. Sewer Trench
11	E. Sewer Trench
12	Haul Road-Center (Lift # 2)

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

ESTED FOR
Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT
Radioactive Residence Complex

DATE 5/9/89

OUR REPORT NO 423-80068-004 Page 3 of 6

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
13	5/9/89	-17"		121.8	16.5	117.2	96.2	1-C-A
14		-12"		121.8	18.2	108.6	89.1	1-B
15		7'4"		121.8	16.3	104.1	85.5	1-B
16		-12"		121.8	15.7	119.0	97.7	1-C-A
17		7'4"		121.8	18.1	120.6	99.0	1-A
18		-4'0"		108.8	17.7	108.6	99.8	1-A

TEST LOCATION:

13	E. Sewer Trench-Retest
14	E. Sewer Trench
15	Haul Road-Center Old Dirt # 108.8
16	E. Sewer Trench-Retest
17	Haul Road-Center- (Retest)
18	Haul Road (Garage 110)

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION. Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5. SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

PSI A-100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/9/89

OUR REPORT NO 423-80068-004

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
19	5/9/89	-4'0"		108.8	18.2	108.5	99.7	1-A
20		-26"		121.8	15.5	119.6	92.9	1-B
21		-9"		121.8	11.1	119.7	92.9	1-B
22		-25"		121.8	15.5	122.3	100.4	1-C-A
23		-9"		121.8	12.5	121.4	99.7	1-A
24		-21"		121.8	14.2	121.1	99.9	1-A

TEST LOCATION:

19	Haul Road (Garage 112)
20	W. Sewer Trench
21	E. Sewer Trench
22	W. Sewer Trench-Retest
23	E. Sewer Trench-Retest
24	W. Sewer Trench

NOTES DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT Radioactive Residence Complex
Lansdowne, PA

DATE May 9, 1989

OUR REPORT NO. 423-80068-004 Page 5 of 6

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
25	5/9/89	-16"		121.8	18.1	112.7	92.5	1-B
26		-6'8"		121.8	14.2	120.5	98.9	1-A
27		-43"		121.8	12.8	111.1	91.2	1-B
28		-45"		121.8	14.1	116.5	95.7	1-A
29		-14"		121.8	17.9	115.5	94.8	1-C-B
30		-13½"		121.8	17.5	117.4	96.4	1-C-A

TEST LOCATION:

25	W. Sewer Trench
26	Haul Road Center
27	Haul Road (Garage 110)
28	Haul Road (Garage 112)
29	W. Sewer Trench Retest
30	W. Sewer Trench Retest

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5. SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE: May 9, 1989

OUR REPORT NO. 423-80068-004 Page 6 of 6

TEST DATA:

TEST NO	DATE	DEPTH / ELEV	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
31	5/9/89	-10"		121.8	18.5	119.0	97.7	1-B
32		-10"		121.8	17.2	120.6	99.0	1-C-A
33		-6'8"		121.8	16.0	115.6	94.9	1-B

TEST LOCATION:

31	W. Sewer Trench
32	W. Sewer Trench Retest
33	Haul Road Center

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

cc: 1-Client, Don Carlucci
1-~~Bill Seitz @ PO Box 189, Lansdowne, PA 19050~~

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/15/89

OUR REPORT NO. 423-80068-005

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/15/89	-8'6"		121.8	14.9	120.1	98.6	1-A
2	5/15/89	-8'6"		121.8	15.3	120.5	98.9	1-A
3	5/15/89	-27"		121.8	13.9	114.0	93.6	1-B
4	5/15/89	-20"		121.8	16.1	117.6	96.5	1-A
5	5/15/89	-27"		121.8	13.7	115.3	95.7	1-A
6	5/15/89	-15"		121.8	15.5	119.4	98.0	1-A

TEST LOCATION:

1	Haul Road Center
2	Haul Road Center
3	W Sewer Trench
4	E Sewer Trench
5	W Sewer Trench-Retest
6	E Sewer Trench

NOTES DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Respectfully submitted,
Professional Service Industries, Inc.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/15/89

OUR REPORT NO 423-80068-005 Page 2 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	5/15/89	-21"		121.8	17.9	107.0	87.8	1-B
8	5/15/89	-21"		121.8	17.1	112.6	92.4	1-B
9	5/15/89	-27"		121.8	17.1	114.7	94.2	1-B
10	5/15/89	-20"		121.8	17.6	113.6	93.3	1-B

TEST LOCATION:

7	Center Sewer Trench (Connecting E & W sewer trench).
8	Center Sewer Trench-Retest.
9	W Sewer Trench
10	Center Sewer Trench-Retest.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Compaction work halted after Test No. 10 due to excessive moisture in fill material.

Inspector: Sherrill Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 198, Lansdowne, PA

R. B. Lukens, Div. Manager

PSI A 100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

DAILY FIELD REPORT

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/17/89

OUR REPORT NO.: 423-80068-006

WEATHER:

TEMPERATURE RANGE: TO:

INSPECTOR: J. Archibald

TYPE OF INSPECTION BEING PERFORMED

X SOILS
___ FOUNDATIONS
___ CONTROLLED FILL (COMPACTION)
X Sample Pick-up

___ ASPHALT
___ BATCH PLANT
___ PLACEMENT (JOB SITE)

___ CONCRETE
___ BATCH PLANT
___ PLACEMENT (JOB SITE)

___ OTHER

BRIEF RESUME OF WORK ACCOMPLISHED THIS DATE:

Secured sample of fill material for Standard Proctor: (ASTM D-698). Returned to lab to run new proctor, which has a higher maximum dry density. See attached report.

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Man.

cc: ~~1 Client, Don Carlucci~~
1-Bill Seitz @ PO Box 198, Lansdowne, PA

psi
Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division
650 Elmwood Avenue
Sharon Hill, Pennsylvania 19079
215/237-6363

MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project
Radioactive Residence Complex
Lansdowne, PA

Report Date	Report No.	PTL-II Order No.
5/18/89	006A	423-80068
Client Order No.	**Page**	**Lab No.**
PSI 423-037	of	890506

Client
Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

Source of Sample
Borrow Material

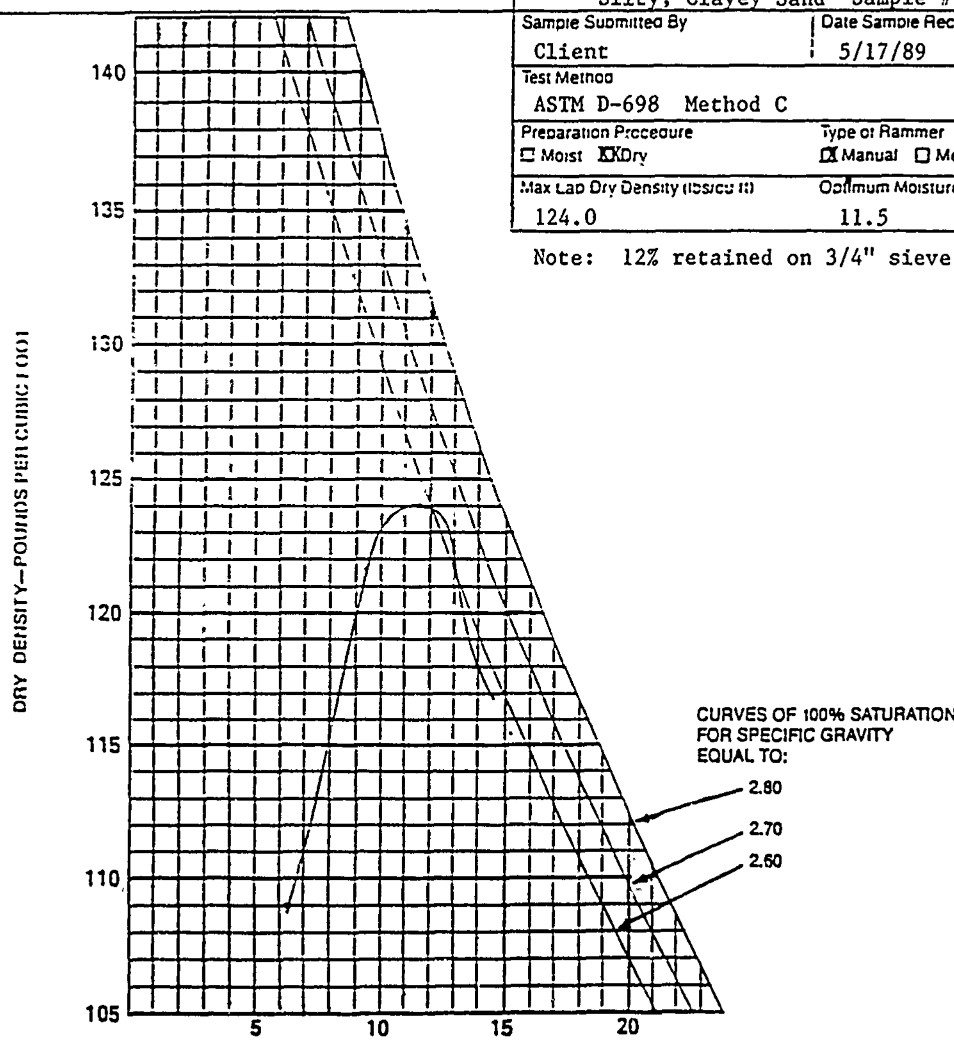
Soil Description
Silty, Clayey Sand -Sample # 2

Sample Submitted By	Date Sample Received
Client	5/17/89

Test Method
ASTM D-698 Method C

Preparation Procedure	Type of Rammer
☐ Moist ☒ Dry	☒ Manual ☐ Mechanical
Max Lab Dry Density (lbs/cu ft)	**Optimum Moisture (%)**
124.0	11.5

Note: 12% retained on 3/4" sieve.



Distribution/Remarks
cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne

Submitted By:
PROFESSIONAL SERVICE IND. INC.

R. B. Lukens, Division Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE May 19, 1989

OUR REPORT NO. 423-80068-007

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT* COMPACTION	COMMENT*
1	5/19/89	1st lift	2	124.0	13.4	120.1	96.9	1-A
2	5/19/89	-21"	2	124.0	10.2	115.4	94.8	1-A
3	5/19/89	-21"	2	124.0	9.5	115.8	95.1	1-A
4	5/19/89	-21"	2	124.0	11.1	118.3	97.1	1-A

TEST LOCATION:

1	E. Sewer Lateral Trench-20' behind curb
2	Behind curb @ W. Sewer Trench
3	Behind curb @ E. Sewer Trench
4	Behind curb 15 east of E. Sewer Trench

NOTES: DENSITIES SHOWN: Lbs per cubic foot
WATER CONTENT: Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6. OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 198, Lansdowne, PA

Inspector: R. B. Lukens

Respectfully submitted,
Professional Service Industries, Inc.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

DAILY FIELD REPORT

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/19/89

OUR REPORT NO.: 423-80068-007A

WEATHER: Clear

TEMPERATURE RANGE: 80 TO

INSPECTOR: R. B. Lukens

TYPE OF INSPECTION BEING PERFORMED

X SOILS
- ___ FOUNDATIONS
- X CONTROLLED FILL (COMPACTION)
- X Site consultation

___ ASPHALT
- ___ BATCH PLANT
- ___ PLACEMENT (JOB SITE)

___ CONCRETE
- ___ BATCH PLANT
- ___ PLACEMENT (JOB SITE)

___ OTHER

BRIEF RESUME OF WORK ACCOMPLISHED THIS DATE: Reported to job site to conduct sand cone test to correlate and confirm density readings of Troxler Nuclear Gauge on 5/15/89. Results confirmed gauge reading to be acceptable and on the conservative side, assuring minimum compaction. Retested saturated test areas which did not meet minimum compaction on 5/15/89. All areas had dried out and passed retests (See Report 007). Discussed and reviewed job specs and conditions with Corps of Engineers Representative.

cc: 1-Client, Don Carlucci
1-Bill Seitz @ PO Box 198, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/21/89

OUR REPORT NO.: 423-80068-008 Page 1 of 3

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/21/89	-8"	2	124.0	12.4	119.2	96.1	1-A
2	5/21/89	Final	2	124.0	15.0	119	96.0	1-B
3	5/21/89	-7'	2	124.0	13.0	122.2	98.6	1-A
4	5/21/89	Final	2	124.0	14.1	122.5	98.8	Retest of # 2 1-A-C
5	5/21/89	-6'4"	2	124.0	12.1	118.9	96.0	96% accepted by 1-A COE Rep.
6	5/21/89	-5'8"	2	124.0	13.1	118.4	95.5	Note: Needs 98% 1-B

TEST LOCATION:

1	Sewer line along curb center.
2	Sewer line along curb center.
3	Fill for #110 garage.
4	Sewer line along curb west center.
5	Fill for #110 garage.
6	Fill for #110 garage.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6. OTHER

A. TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT Radioactive Residence Complex
Lansdowne, PA

DATE 5/21/89

OUR REPORT NO 423-80068-008 Page 2 of 3

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	5/21/89	-5'8"	2	124.0	13.2	121.9	98.3	1-A-C
8	5/21/89	-5'2"	2	124.0	14.1	118.0	95.2	95% accepted by C.E.O. Rep. 1-A
9	5/21/89	-4'8"	2	124.0	11	116.6	94	1-B
10	5/21/89	-4'2"	2	124.0	11	119.2	96.2	Accepted by CEO Rep. 1-A-C
11	5/21/89	-3'8"	2	124.0	10.6	122	98.3	1-A
12	5/21/89	-3'4"	2	124.0	11.5	122.6	98.8	1-A

TEST LOCATION:

7	Fill for # 110 garage-Retest
8	" "
9	" "
10	" "
11	" "
12	" "

NOTES: DENSITIES SHOWN. Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION: Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

Respectfully submitted,
Professional Service Industries, Inc.

psi Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

* 5/23/89
* Revised to show correct depth for Test No. 13.

DATE 5/21/89 OUR REPORT NO. 423-80068-008 Page 3 of 3

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
13	5/21/89	-3'2"		124.0	12.3	123.9	99.9	1-A
14	5/21/89	-2'10"		124.0	12.5	125.3	101.1	1-A
15	5/21/89	-2'6"		124.0	12.2	123.3	99.4	1-A
16	5/21/89	-8'		124.0	12.3	126.2	101.8	1-a

TEST LOCATION:

13	Fill for #112 garage
14	Fill for #110 garage
15	Fill for #112 garage
16	Center of lot

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION. Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5. SOIL CEMENT
6. OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 198, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Man.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/22/89

OUR REPORT NO.: 423-80068-009 Page 1 of 4

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/22/89	-2'6"	2	124.0	13.1	124.0	100.0	1-A
2	5/22/89	-2'6"	2	124.0	13.8	123.8	99.8	1-A
3	5/22/89	10.33*	2	124.0	12.9	119.7	96.6	1-A
4	5/22/89	-1'6"	2	124.0	10.1	119.5	96.4	1-A
5	5/22/89	-2'0"	2	121.8	9.3	117.1	96.1	1-A
6	5/22/89	-2'0"	2	121.8	9.9	118.1	97.0	1-A-C

TEST LOCATION:

1	#112 garage
2	#110 garage
3	Center area-40' from back cut line, 70' from #115 property line.
4	#112 Driveway
5	#110 garage
6	#110 garage-Retest after 1st compaction

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Garage Areas: 98% for last 12"; 95% for lifts below 12" depth
* Lift elevation, based on reference elevation °F 5.14

Inspector: R. B. Lukens

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/22/89

OUR REPORT NO.: 423-80068-009 Page 2 of 4

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	5/22/89	-2'0"	2	121.8	8.9	121.2	99.5	1-C-A
8	5/22/89	-2'0"	2	121.8	8.4	116.6	95.7	1-A
9	5/22/89	-2'0"	2	121.8	9.1	119.3	97.9	1-A
10	5/22/89	-2'0"	2	121.8	9.4	119.6	98.2	1-A
11	5/22/89	10.00	2	121.8	11.3	122.6	100.6	1-A
12	5/22/89	-1'6"	2	121.8	8.6	120.1	98.6	1-A

TEST LOCATION:

7	#110 Garage-Retest after 2nd recompaction
8	#110 Garage-S. Side
9	#110 Garage-N. Side
10	#112 Garage
11	Center Area
12	#112 Garage-Middle

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6. OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Respectfully submitted,
Professional Service Industries, Inc.

Inspector: S. Rhodes

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/22/89

OUR REPORT NO. 423-80068-009 Page 3 of 4

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
13	5/22/89	-1'6"	1	121.8	13.7	118.5	97.3	1-A
14	" "	-0'6"	1	121.8	11.6	115.0	94.4	1-B
15	" "	" "	"	" "	9.7	120.1	98.6	1-A
16	" "	" "	"	" "	10.4	119.1	97.8	1-C-A
17	" "	-1'0"	"	" "	10.9	" "	97.9	1-A
18	" "	" "	"	" "	12.0	122.6	100.7	1-A

TEST LOCATION:

13	#110 Garage-North Side
14	24' off of #115 property line & 56' off of back cut line.
15	15' off of back cut line & 48' off of #115 property line.
16	Retest- 21' off #115 property & 51' off of back cut line.
17	#110 Garage-West Side
18	#112 Garage-East Side

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: S. Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE: 5/22/89

OUR REPORT NO.: 423-80068-009 Page 4 of 4

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
19	5/22/89	-0'6"	1	121.8	9.9	119.7	98.3	1-A
20	" "	" "	"	" "	10.8	119.7	98.3	1-A
21	" "	" "	"	" "	13.0	118.0	96.9	1-B
22	" "	" "	"	" "	11.9	119.7	98.3	1-C-A
23	" "	Finish subgrade	"	" "	11.0	124.7	102.4	1-A

TEST LOCATION:

19	-12' off of back line & 35' off of #115 property line.
20	#110 Garage-Center
21	#112 Garage-North
22	#112 Garage-North-retest
23	-10' off of back line & 33' off of #115 property line.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT: Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:
Inspector: S. Rhodes

cc: 1-Client, Don Carlucci
1-Bill Seitz @ PO Box 198, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

psi Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA

DATE 5/23/89

OUR REPORT NO. 423-80068-010

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/23/89	Finished Subgrade	1	121.8	11.8	116.9	93.7	1-B
2	" "	" "	"	" "	11.9	118.0	96.8	1-C-B
3	" "	" "	"	" "	10.8	124.1	101.9	1-C-A
4	" "	-6"	"	" "	12.5	118.1	97.0	1-A
5	" "	-2'	"	" "	12.1	117.9	96.8	1-A
6	" "	Finished Subgrade	"	" "	13.3	120.8	99.2	1-A

TEST LOCATION:

1	#112 Garage-Center
2	#112 Garage-Retest Center after 1st recompaction.
3	#112 Garage-Retest Center after 2nd recompaction.
4	12' off of back line & 45' off of #115 property line.
5	27' off of #115 property line & 54' off of back line.
6	#110 Garage-Center

NOTES: DENSITIES SHOWN: Lbs per cubic foot
WATER CONTENT: Per Cent of dry weight
PERCENT COMPACTION: Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: S. Rhodes

cc; 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 198, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/25/89

OUR REPORT NO 423-80068-011 Page 1 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/25/89	10.60	1	121.8	14.0	119.4	98.0	1-A
2	5/25/89	11.56	1	124.0	12.2	125.5	101.2	1-A
3	5/25/89	11.56	1	124.0	14.4	121.1	97.8	1-A
4	5/25/89	11.56	1	121.8	15.3	119.7	98.3	1-A
5	5/25/89	11.35	1	121.8	14.7	120.3	98.7	1-A
6	5/25/89	9.75	1	121.8	12.9	119.7	98.3	1-A

TEST LOCATION:

1	75' from back line, 50' from #115 prop line
2	Haul Road- 65' from street
3	Haul Road- 50' from street
4	Haul Road- 25' from street
5	Haul Road- 21' from street
6	Haul Road 39' from back line, 38' from #115 prop line

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS: Ref. Elev.: 4.95

Inspector: R. Lukens, S. Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Manager

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE 5/25/89

OUR REPORT NO.: 423-80068-011 Page 2 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
7	5/25/89	10.52	1	121.8	15.5	115.7	95.0	1-A
8	5/25/89	9.90	1	121.8	9.9	120.8	99.2	1-A

TEST LOCATION:

7	33' from street
8	18' from street

NOTES. DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS: Ref. Elev: 4.95
Inspector: S. Rhodes

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Division Manage

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division
REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE May 26, 1989

OUR REPORT NO.: 423-80068-012 Page 1 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION •	COMMENT •
1	5/26/89	10.20		121.8	12.1	118.8	97.5	1-A
2	5/26/89	8.02		121.8	11.1	123.3	101.3	1-A
3	5/26/89	9.90		121.8	13.6	118.1	97	1-A
4	5/26/89	9.54		121.8	13.7	121.3	99.6	1-A
5	5/26/89	7.80		121.8	12.3	120.1	98.6	1-A
6	5/26/89	8.82		121.8	11.0	120	98.5	1-A

TEST LOCATION:

1	Center 75' from #115 prop line, 75' from street
2	50' from back line, 75' from prop line.
3	30' from prop line, 50' from street
4	Haul road west side, 35' from street
5	Haul road west side, 75' from back line
6	Center of site, 75' from back line

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

• 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Ref. Elv. 5.02
Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 198, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE May 26, 1989

OUR REPORT NO: 423-80068-012 Page 2 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/26/89			N/A	19.2	97.5		
2	5/26/89			N/A	20.5	96.2		
3	5/26/89			N/A	18.4	100.9		

TEST LOCATION:

1	Site material west side of site 25' from street
2	Site material west side of site 40' from street
3	Site material west side of site 60' from street

NOTES. DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B. RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:
Tests to determine moisture, and dry density only.

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz, PO Box 198, Lansdowne, Pa

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

650 Elmwood Avenue • Sharon Hill, PA 19079 • Phone: 215/237-6363

psi Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE May 30, 1989

OUR REPORT NO.: 423-80068-013

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/30/89	8.00		121.8	10.4	119.5	98.1	1-A
2	5/30/89	9.14		121.8	11.1	124.2	102	1-A
3	5/30/89	6.82		121.8	10.3	119	97.7	1-A
4	5/30/89	8.24		121.8	15.0	117.7	96.6	1-A
5	5/30/89	8.60		121.8	13.2	119.8	98.4	1-A
6	5/30/89	7.78		121.8	13.1	122	100.2	1-A

TEST LOCATION:

1	30' from East Prop. Line, 50' from steet
2	70' from East Prop. Line, 20' from back line
3	20' from West Prop. Line, 70' " "
4	25' " " 40' from street
5	50' from East Prop. Line, 50' from street
6	50' from West Prop Line, 80' from street

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4. SUBBASE
5 SOIL CEMENT
6. OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Ref. Elev. 5.12

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne, PA 19050

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

PSI A-100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE: May 31, 1989

OUR REPORT NO: 423-80068-014

TEST DATA:

TEST NO	DATE	DEPTH / ELEV	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	5/31/89	7.70		121.8	15.0	120.4	98.9	1-A
2	5/31/89	9.20		121.8	10.2	119.5	98.1	1-A
3	5/31/89	8.60		121.8	13.2	123.1	101.1	1-A
4	5/31/89	7.24		121.8	16.0	118.0	96.8	1-A

TEST LOCATION:

1	25' from west prop line, 25' from street
2	60' from west prop line, 25' from back line
3	40' from east prop line, 20' from street
4	40' from street, 25' from west prop line

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION. Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5. SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Ref. Elev. 5.08

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

PSI A-100-2

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE: June 1, 1989

OUR REPORT NO. 423-80068-015

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	6/1/89	Final		121.8	12.2	121.8	100.0	1-A
2	6/1/89	Final		121.8	9.5	120.9	99.3	1-A

TEST LOCATION:

1	20' from back line, 50' from west prop line.
2	30' from back line, 35' from east prop line.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION. Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5. SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz, @ PO Box 189, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR: Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE June 2, 1989

OUR REPORT NO 423-80068-016 Page 2 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
5	6/2/89	Footing Bottom		121.8	14.6	117.7	96.6	1-B
6	6/2/89	" "		121.8	12.2	120.9	99.1	1-A
7	6/2/89	" "		121.8	15.2	122.9	101.0	1-A
8	6/2/89	" "		121.8	16	120.0	98.4	1-A
9	6/2/89	" "		121.8	14.7	122.9	101.0	1-A

TEST LOCATION:

5	N W corner of #110 garage footing.
6	S E corner of #112 garage footing.
7	N W corner of #112 garage footing.
8	N W corner of #110 garage footing.
9	S E corner of #110 garage footing.

NOTES DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION: Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

cc: 1-Client, Don Carlucci
1-Client, Bill Seitz @ PO Box 189, Lansdowne, PA

Respectfully submitted,
Professional Service Industries, Inc.

R. B. Lukens, Div. Mgr.

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

REPORT OF FIELD COMPACTION TESTS

TESTED FOR Carlucci Construction Co., Inc.
401 Meadow Street
Cheswick, PA 15024

Attn: Don Carlucci

PROJECT: Radioactive Residence Complex
Lansdowne, PA 19050

DATE June, 2, 1989

OUR REPORT NO: 423-80068-016 Page 1 of 2

TEST DATA:

TEST NO	DATE	ELEV / DEPTH	SOIL ID NUMBER	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN PLACE DRY DENSITY	PER CENT COMPACTION	COMMENT *
1	6/2/89	Final		121.8	10.3	121.2	99.5	1-A
2	6/2/89	Final		121.8	11.8	121.7	99.9	1-A
3	6/2/89	Final		121.8	10.9	123.2	101.2	1-A
4	6/2/89	Final		121.8	9.5	126	103.5	1-A

TEST LOCATION:

1	35' from street, 40' from east prop line.
2	25' from street, 40' from west prop line.
3	15' from street, 20' from west prop line.
4	Center of site.

NOTES: DENSITIES SHOWN Lbs per cubic foot
WATER CONTENT Per Cent of dry weight
PERCENT COMPACTION Based on maximum dry density obtained on sample indicated by soil ID number

* 1 FILL MATERIAL
2 BACKFILL
3 BASE COURSE
4 SUBBASE
5 SOIL CEMENT
6 OTHER

A TEST RESULTS COMPLY WITH SPECIFICATIONS
B RECOMPACTION REQUIRED
C TEST IS AFTER RECOMPACTION

REMARKS:

Inspector: J. Archibald

Respectfully submitted,
Professional Service Industries, Inc.

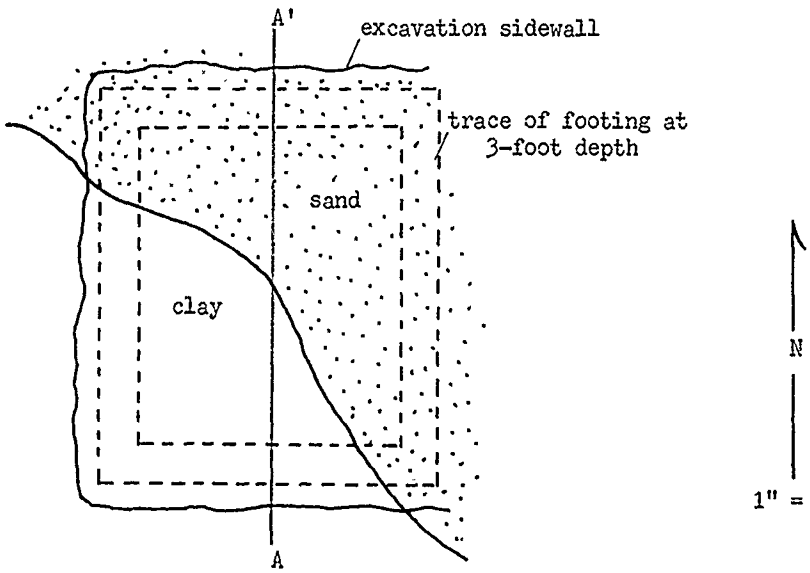
APPENDIX E

SETTLEMENT ANALYSIS FOR 110 E. STEWART AVENUE REPLACEMENT GARAGE

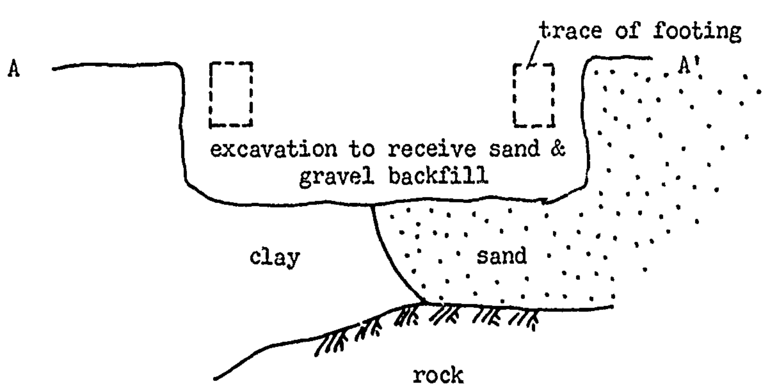
Settlement Analysis: Gretzenberg Garage

A. GEOLOGY

1. Plan of Existing Excavation Floor at 6.7-foot Depth.



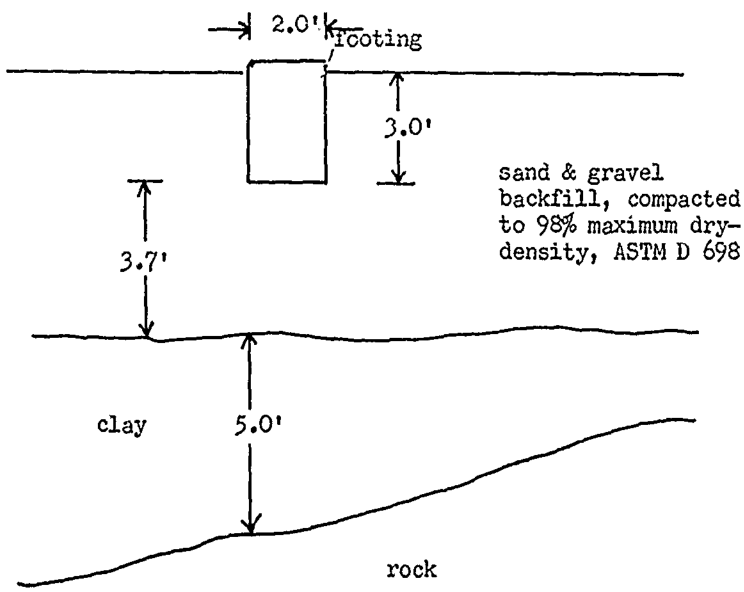
2. Cross Section of Existing Garage-Excavation along A-A'



Settlement Analysis: Gretzenberg Garage
(Continued)

B. SETTLEMENT CALCULATIONS FOR BASE OF FOOTING AT THE 3-FOOT DEPTH, WITH 3.7' OF COMPACTED SAND AND GRAVEL BACKFILL BENEATH FOOTING AND 5-FOOT CLAY LAYER BENEATH BACKFILL.

1. Calculation of Stress at Top of Clay Layer.



a. Calculation of Influence Factor

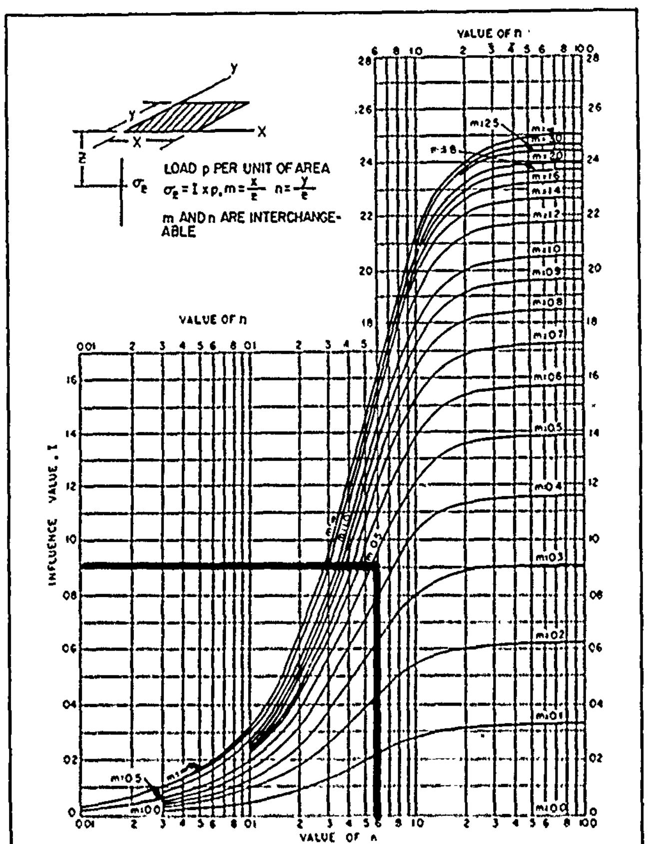


FIGURE 4
Influence Value for Vertical Stress Beneath a Corner of a Uniformly Loaded Rectangular Area (Boussinesq Case)

Depth to clay layer below base of footing = 3.7' = z

Footing Width = 2.0' = x; Footing Length = 20.3' = y

$m = x/z = 2.0/3.7 = 0.54$; $n = y/z = 20.3/3.7 = 5.5$

$I = 0.09$

Settlement Analysis: Gretzenberg Garage
(Continued)

b. Calculation of Surcharge at top of clay layer from load of garage.

Estimated stress on soil at base of footing from wood-frame and stucco garage:

5.5 psi

Influence factor at top of clay layer:

$0.09 = I$

Surcharge on top of clay layer:

$\Delta\sigma_v = (5.5 \text{ psi})(0.09) = 0.5 \text{ psi}$

2. Calculation of Primary Consolidation

a. Calculation of geostatic stress (v) at center of clay layer.

Depth to center of clay as measured from base of footing:

3.7' sand & gravel + 2.5' clay = 6.2 feet.

$$\sigma_v = 0.75 \text{ psi/ft}(6.2 \text{ ft})$$
$$= 4.65 \text{ psi}$$

b. Estimate of Coefficient of Consolidation (after Terzahgi and Peck)

$$C_c = 0.009(LL - 10)$$
$$= 0.009(70 - 10)$$
$$= 0.54$$

c. Estimate Of Void Ratio Typical of Soft, Normally-Consolidated Clay.

$e_o = 1.30$

d. Thickness of Consolidating-Clay Horizon (from page 1).

H = 5.0 feet = 60 inches

e. Primary Settlement Calculation.

$$\rho_p = (C_c/1+e_o)(H)[\log_{10}(\sigma_v+\Delta\sigma_v)/\sigma_v]$$
$$= (0.54/1+1.3)(60 \text{ in})[\log_{10}(4.65+0.5)/4.65]$$
$$= 0.24(60 \text{ in})(\log_{10}5.15 - \log_{10}4.65)$$
$$= 14.4 \text{ inches}(0.712 - 0.667)$$
$$= 14.4 \text{ inches}(0.045)$$
$$\rho_p = 0.65 \text{ inch}$$

3. Calculation of Secondary Consolidation

a. Estimate of Coefficient of Secondary Consolidation (C_a after Godlewski)

$C_a/C_c = 0.05$

$C_a/0.54 = 0.05$

$C_a = 0.027$

b. Void Ratio after Primary Consolidation — e_p

$$e_p = e_o(H_p)/H_o$$

$$H_p = H_o - \rho_p$$
$$= 60 - 0.65$$
$$= 59.35 \text{ inches}$$

$$e_p = 1.30(59.35)/60$$
$$= 1.29$$

c. Calculation of Secondary Consolidation over 25 Years, Assuming Primary Consolidation is Complete after 5 Years.

$$\rho_s = (C_a/1+e_p)(H_o)(\log_{10}25/5)$$
$$= (0.027/1+1.29)(60)(\log_{10}25 - \log_{10}5)$$
$$= 0.71(1.40 - 0.7)$$
$$= 0.5 \text{ inches}$$

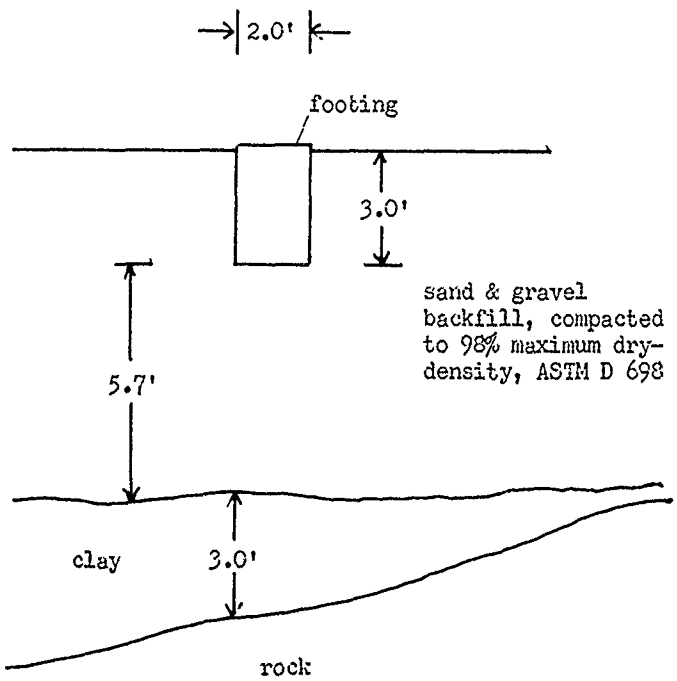
4. Calculation of Total Settlement.

$$\rho_T = \rho_p + \rho_s$$
$$= 0.65 + 0.5$$
$$= 1.15 \text{ inches}$$

CONCLUSION: 1.15 INCHES OF DIFFERENTIAL SETTLEMENT IS EXCESSIVE. THE EXCAVATION FOR THE GARAGE FOUNDATION WILL HAVE TO BE DEEPENED TO REMOVE UNSUITABLE CLAY.

C. SETTLEMENT CALCULATION FOR BASE OF FOOTING AT THE 3-FOOT DEPTH, 5.7 FEET OF COMPACTED SAND AND GRAVEL BACKFILL BENEATH FOOTING. 3 FEET OF CLAY BENEATH BACKFILL.

1. <u>Calculation of Stress at Top of Clay Layer</u>.



a. Calculation of Influence Factor

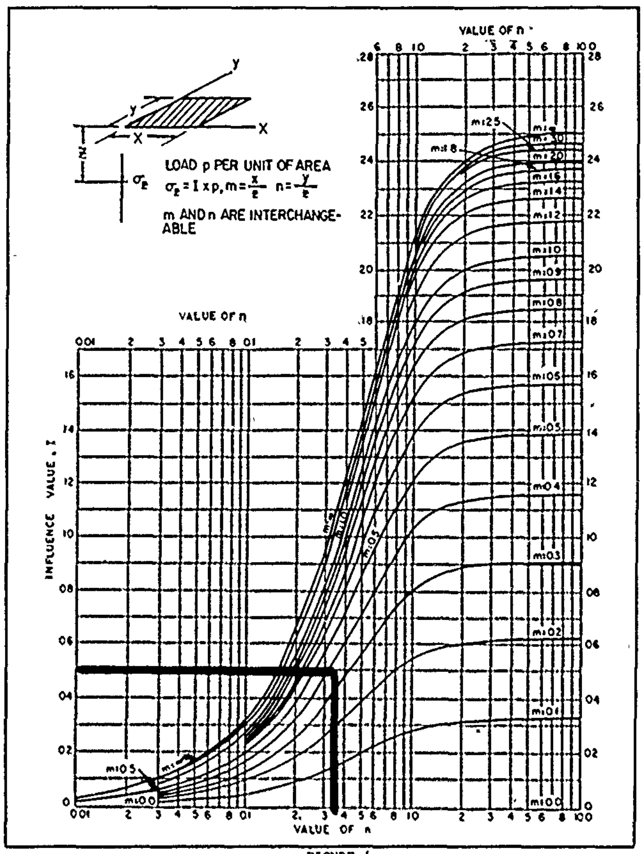


FIGURE 4
Influence Value for Vertical Stress Beneath a Corner of a Uniformly Loaded Rectangular Area (Boussinesq Case)

Depth to clay layer below base of footing = 5.7' = z
Footing Width = 2.0' = x; Footing Length = 20.3' = y
$m = x/z = 2.0/5.7 = 0.35$; $n = y/z = 20.3/5.7 = 3.6$

$I = 0.05$

Settlement Analysis: Gretzenberg Garage
(Continued)

b. Calculation of Surcharge at Top of Clay Layer from Load of Garage.

Estimated stress on soil at base of footing from wood-frame and stucco garage:

5.5 psi

Influence factor at top of clay layer:

$0.05 = I$

Surcharge on top of clay layer:

$\Delta\sigma_v = (5.5 \text{ psi})(0.05) = 0.28 \text{ psi}$

2. Calculation of Primary Consolidation

a. Calculation of Geostatic Stress (v) at center of Clay Layer

Depth to center of clay as measured from base of footing:

5.7' sand and gravel + 1.5' clay = 7.2 feet.

$$\sigma_v = 0.75 \text{ psi/ft}(7.2 \text{ ft})$$
$$= 5.4 \text{ psi}$$

b. Estimate of Coefficient of Consolidation (after Terzahgi and Peck)

$$C_c = 0.009(LL - 10)$$
$$= 0.009(70 - 10)$$
$$= 0.54$$

c. Estimate of Void Ratio Typical of Soft, Normally -Consolidated Clay

$e_o = 1.30$

d. Thickness of Consolidating-Clay Horizon

H = 3.0 ft = 36 inches

e. Primary Settlement Calculation

$$\begin{aligned}
\rho_p &= (C_c/1{+}e_o)(H)[\log_{10}(\sigma_v{+}\Delta\sigma_v)/\sigma_v] \\
&= (0.54/1{+}1.3)(36 \text{ in})[\log_{10}(5.4{+}0.28)/5.4] \\
&= 0.23(36 \text{ in})(\log_{10}5.68 - \log_{10}5.4) \\
&= 8.28 \text{ inches}(0.754 - 0.732) \\
&= 8.28 \text{ inches}(0.022) \\
\rho_p &= 0.18 \text{ inch}
\end{aligned}$$

3. Calculation of Secondary Consolidation

a. Estimate of Coefficient of Secondary Consolidation (C_a after Godlewski)

$$\begin{aligned}
C_a/C_c &= 0.05 \\
C_a/0.54 &= 0.05 \\
C_a &= 0.027
\end{aligned}$$

b. Void Ratio after Primary Consolidation — e_p

$$e_p = e_o(H_p)/H_o$$

$$H_p = H_o - \rho_p$$
$$= 36 - 0.18$$
$$= 35.82 \text{ inches}$$

$$e_p = 1.30(35.82)/36$$
$$= 1.29$$

c. Calculation of Secondary Consolidation over 25 Years, Assuming Primary Consolidation is Complete after 5 Years.

$$\rho_s = (C_a/1{+}e_p)(H_o)(\log_{10}25/5)$$
$$= (0.027/1{+}1.29)(36)(\log_{10}25 - \log_{10}5)$$
$$= 0.42(1.40 - 0.7)$$
$$= 0.29 \text{ inches}$$

4. Calculation of Total Settlement

$$\rho_T = \rho_p + \rho_s$$
$$= 0.18 + 0.29$$
$$= 0.47 \text{ inches}$$

CONCLUSION: 0.47 INCHES OF SETTLEMENT OVER A 25-YEAR PERIOD IS TOLERABLE FOR A WOOD-FRAME STRUCTURE. THE EXCAVATION FOR THE GARAGE FOUNDATION WILL HAVE TO BE DEEPENED BY AN ADDITIONAL TWO FEET TO LIMIT SETTLEMENT TO ONLY 0.47 INCHES.

APPENDIX F

SPECIFICATIONS FOR REPLACEMENT GARAGE CONSTRUCTION

Quality Dedication

UNLIMITED CEILINGS

By

Mary Ann Baker, General Contractor/Owner

Droped Ceilings — Commercial & Residential

Steel or Wood Stud Framing Drywall Installations

We do it all better to last longer with quality workmanship

215-485-6552

P.O. Box 1357 **Linwood, PA 19061**

5-4-89

Estimate to build 2 garages to specs and guidelines set forth to originality as close as possible with exception of doors and shingles:

Garage #1-20'x20' with 15' peak and 2 wood roll-up garage doors.

1. Install footings 3" deep with re-bars.
2. Install concrete block semi-solids to within 4" above grade.
3. Install anchors in block on 6' centers.
4. Install 6" 3500 pd concrete slab using wire mesh for re-enforcing.
5. Install 2"x8" treated plate.
6. Install 2x4 studs on 16" centers for walls.
7. Install double plate top of walls using 2"x4",s.
8. Install 2"x8" roof rafters and collars(beams).
9. Cover walls with ½" sheathing.
10. Cover roof with 5/8" sheathing.
11. Install 3-2"x10" headers over doors across front.
12. Install 2"x6" joists on 4' centers.
13. Install 15pd felt and 20 year certeened shingles to roof.
14. Install Stucco to 4 sides using wire and 2 coats stucco.
15. Paint and finish exterior to match house.
16. Install 20'x14'x6" concrete pad in front of garage.
17. We will be using tie downs on all rafters and joists.

1.5% interest compounded daily on unpaid balance.
Payment due upon completion — unless written into contract — 50% deposit required on all work.

.lity Dedication

UNLIMITED CEILINGS

By

Mary Ann Baker, General Contractor/Owner

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Steel or Wood Stud Framing Drywall Installations

We do it all better to last longer with quality workmanship

215-485-6552

P.O. Box 1357 Linwood, PA 19061

Garage #2-20'x18' with 16' peak and attic storage space with no ladder or steps, roll-up wood doors.

1. Install footing 3' deep with re-bars.
2. Install semi-solid concrete block to within 4" above grade.
3. Install anchors on 6' centers.
4. Install 6" re-enforced 3500pd slab using wire mesh.
5. Install 2"x8" treated plate.
6. Install 2"x4" stud walls on 16" centers.
7. Install double 2"x4" plate at top of walls.
8. Install 2"x8' roof rafters on 15" centers.
9. Install 2"x10" joists on 16" centers and cover with 5/8" plywood 2nd floor storage area with entry in center of garage.
10. Install post in center of garage (steel).
11. Install collar beams to code.
12. Install ½" plywood sheathing to side walls.
13. Install 5/8" plywood sheathing to roof.
14. 15pd felt and 20 year certeened shingles to roof.
15. Stucco all walls using wire mesh and 2 coats of stucco.
16. Paint 2 coats M.A.B. paints to finish, same color as house.
17. We will be using tie downs on all rafters and joists.

MAKE ALL CHECKS PAYABLE TO:
Mary Ann Baker, G. C.
Balance due 10 days after Completion.....

We will meet government wage proposals.

1.5% interest compounded daily on unpaid balance.
Payment due upon completion — unless written into contract — 50% deposit required on all work.

APPENDIX G

THE "PAYMENT ANALYSIS METHOD" FOR SUBMITTING AND CHECKING CONTRACTOR REQUESTS FOR PROGRESS PAYMENTS

U.S. Army Corps of Engineers
Lansdowne Radioactive Residence Complex
Dismantlement/Removal Project
105-107 East Stratford Avenue
Lansdowne, Pennsylvania 19050
(215) 622-2350

ANALYSIS OF PAYMENT DUE CONTRACTOR FOR WORK PERFORMED IN FEBRUARY, 1989

prepared for

Chem-Nuclear Systems, Inc.
220 Stoneridge Drive, Columbia, S.C. 29210

by

Walter Wickboldt, Project Engineer
Baltimore District, Corps of Engineers
P.O. Box 1715, Baltimore, MD 21203

6 March 89

How This Analysis Was Prepared

1. Unit-Price Work. Payment Analysis for unit-price work appears on pages 3 thru 5. Each unit-price pay item in the contract for which the Contractor is entitled to remuneration was considered separately. All work for the month performed under an applicable unit-price item was identified by rad-waste shipment number and associated quantities of contaminated soil or rubble, beginning with the first day of the month and ending with the last. Shipment quantities for the month were subtotaled to get the quantity for all shipments for the month. Added to this subtotal were quantities that had been shipped the previous month and billed at 33% the previous month, which were now payable for the remaining 67% because the shipment had since reached the disposal site. Finally, subtracted from the subtotal were the quantities shipped this month which fell into the 67% category for payment next month because the shipments have not yet reached the disposal site. In other words, for payment purposes, 67% of the quantities in these shipments are considered as not having been shipped. In summary:

(TOTAL QUANTITY FOR PAYMENT) = (ALL QUANTITIES SHIPPED THIS MONTH) + (THE 67% OF QUANTITIES SHIPPED LAST MONTH FOR WHICH NO PAYMENT WAS RECEIVED) - (67% OF QUANTITIES SHIPPED THIS MONTH FOR WHICH PAYMENT WILL BE RECEIVED NEXT MONTH)

2. Lump-Sum Work. Analysis of payment for lump sum work appears on page 6. The analysis began by looking through the Contractor's updated Earned Value Cost Report through the end of February 1989 and noting which items falling into the lump sum category showed an increase in ACWP over the Earned Value Cost Report for the month of January. Payment for the item was determined as:

(AMOUNT OF PAYMENT) = (THIS MONTH'S ACWP) - (LAST MONTH'S ACWP)

3. Quantity and Payment Summary. This appears on page 7. It consists of a tabulation of all lump sum payments for unit-price work determined by multiplying quantities times unit prices. Total costs for each item are then summed to yield the correct amount of requested payment.

BACKGROUND DATA FOR CHECK OF CNSI FEBRUARY 1989 PAYMENT REQUISITION

Contract Pay Item 1B--Quantities of Contaminated Soil Over 900 Tons.
(Item 2115 in Earned-Value Cost Report)

Rad-Waste Shipment Number	* Tons Gov't. Count	Tons CNSI Count
RW-138 (2/1/89)	21.243	21.243
-139	10.753	10.753
-140		0.000
-141		0.000
-142		0.000
-143		0.000
-144		0.000
-145		0.000
-146		0.000
-147		0.000
-148		0.000
-149		0.000
-150		0.000
-151		0.000
-152		0.000
-153		0.000
-154		0.000
-155		0.000
-156 (2/28/89)	+	+ 0.000
Subtotal:	31.996	31.996
Carryover from Jan. not paid:	+97.230	+ 97.230
Subtotal:	129.226	129.222
Shipped but not billed in Feb.:	- 0	- 0.000
Quantity for February Payment:	129.226	129.222

* (The Project Engineer checks the weight ticket of each rad-waste bin in the shipment and enters the sum of the weights on all tickets for the shipment in the Government Count column. He then compares his tally with that submitted by the Contractor to either confirm or dispute the Contractor's numbers).

BACKGROUND DATA FOR CHECK OF CNSI FEBRUARY 1989 PAYMENT REQUISITION (CONTINUED)

Contract Pay Item 2A--Quantities of Contaminated Rubble Up To 800 Tons. (Item 2270 in Earned Value Cost Report)

Rad-Waste Shipment Number	Tons Gov't Count	Tons CNSI Count
RW-139 (2/2/89)	8.903	8.903
-140	18.415	18.415
-141	19.860	19.860
-142	18.965	18.965
-143	18.900	18.900
-144	18.633	18.633
-145	19.660	19.660
-146	19.368	19.368
-147	18.378	18.378
-148	19.535	19.535
-149	19.358	19.358
-150	19.840	19.840
-151	19.928	19.928
-152	18.950	18.950
* -153 (1/24/89)	+14.046	+ 14.046
Subtotal:	272.739	272.739
Carryover from January not paid:	+ 0	+ 0.000
Subtotal:	272.739	272.739
Shipped but not billed in Feb.:	- 0	- 0.000
Quantity for Feb. Payment:	272.739	272.739

* Part of RW-153 is billed under contract pay-item 2B--Quantities over 800 Tons.

BACKGROUND DATA FOR CHECK OF CNSI FEBRUARY 1989 PAYMENT REQUISITION

Contract Pay Item 2B--Quantities of Contaminated Rubble Over 800 Tons.
(Item 2270 in Earned Value Cost Report)

Rad-Waste Shipment Number	Tons Gov't Count	Tons CNSI Count
RW-153 (2/24/89)	5.839	5.839
* 154	19.288	19.288
* -155	18.880	18.942
* -156 (2/28/89)	+19.715	+ 19.715
Subtotal:	63.722	63.784
Carryover from Jan. not paid:	+ 0	+ 0.000
Subtotal:	63.722	63.784
Shipped but not billed in Feb.:	-38.783	- 38.783
Quantity for February Payment:	24.939	25.001

* Shipment for which 67% of payment is withheld until next month because shipment has not yet arrived at disposal site.

BACKGROUND DATA FOR CHECK OF CNSI FEBRUARY 1989 PAYMENT REQUISITION

Contract Pay Item 4--All Other Work Not Covered in Other Bid Items.

Operations (Item 5100 in Earned Value Cost Report)

CNSI Calculation			Government Calculation		
Feb. ACWP	- Jan.ACWP	= Payment Due	Feb. ACWP	- Jan. ACWP	= Payment Due
$592,920	- $531,584	= $61,336	$592,920	- $531,584	= $ 61,336

Safety (Item 5200 in Earned Value Cost Report)

CNSI Calculation			Government Calculation		
Feb. ACWP	- Jan. ACWP	= Payment Due	Feb. ACWP	- Jan. ACWP	= Payment Due
$181,506	- $158,290	= $23,216	$181,506	- $158,290	= $ 23,216

Radiological Safety (Item 5300 in Earned Value Cost Report)

CNSI Calculation			Government Calculation		
Feb. ACWP	- Jan. ACWP	= Payment Due	Feb. ACWP	- Jan. ACWP	= Payment Due
$414,523	- $361,503	= $53,020	$414,523	- $361,503	= $ 53,020

Other

CNSI Calculation			Government Calculation		
Feb. ACWP	- Jan. ACWP	= Payment Due	Feb. ACWP	- Jan. ACWP	= Payment Due
$	- $	= $	$	- $	= $

QUANTITY AND PAYMENT SUMMARY

CNSI Estimate

	Contract Pay Item	Quantity	Unit	Unit Price	Total Cost
1B.	Contaminated Soil	129.222	ton	$ XXXXX	$ XXXXX
2A.	Contaminated Rubble	272.739	ton	$ YYYYY	$ YYYYY
2B.	Contaminated Rubble	25.001	ton	$ ZZZZZ	$ ZZZZZ
4.	All Other Work:				
	Operations		LS		$ 61,336
	Safety		LS		$ 23,216
	Radiological Safety		LS		+ $ 53,020
			AMOUNT OF REQUESTED PAYMENT:		$816,478

Government Estimate

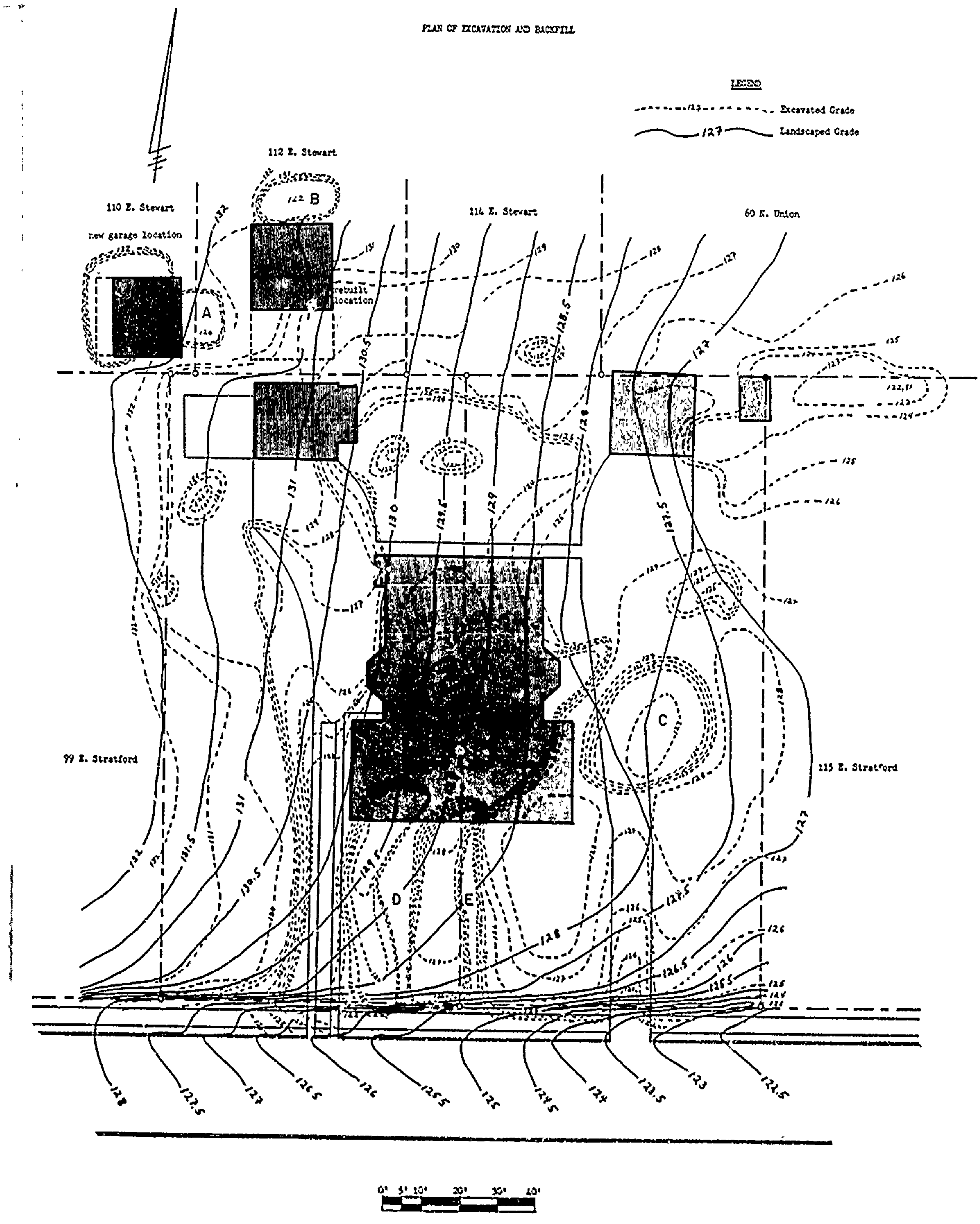
	Contract Pay Item	Quantity	Unit	Unit Price	Total Cost
1B.	Contaminated Soil	129.226	ton	$ XXXXX	$ XXXXX
2A.	Contaminated Rubble	272.739	ton	$ YYYYY	$ YYYYY
2B.	Contaminated Rubble	24.939	ton	$ ZZZZZ	$ ZZZZZ
4.	All Other Work:				
	Operations		LS		$ 61,336
	Safety		LS		$ 23,216
	Radiological Safety		LS		+ $ 53,020
			AMOUNT OF AUTHORIZED PAYMENT:		$ 816,377

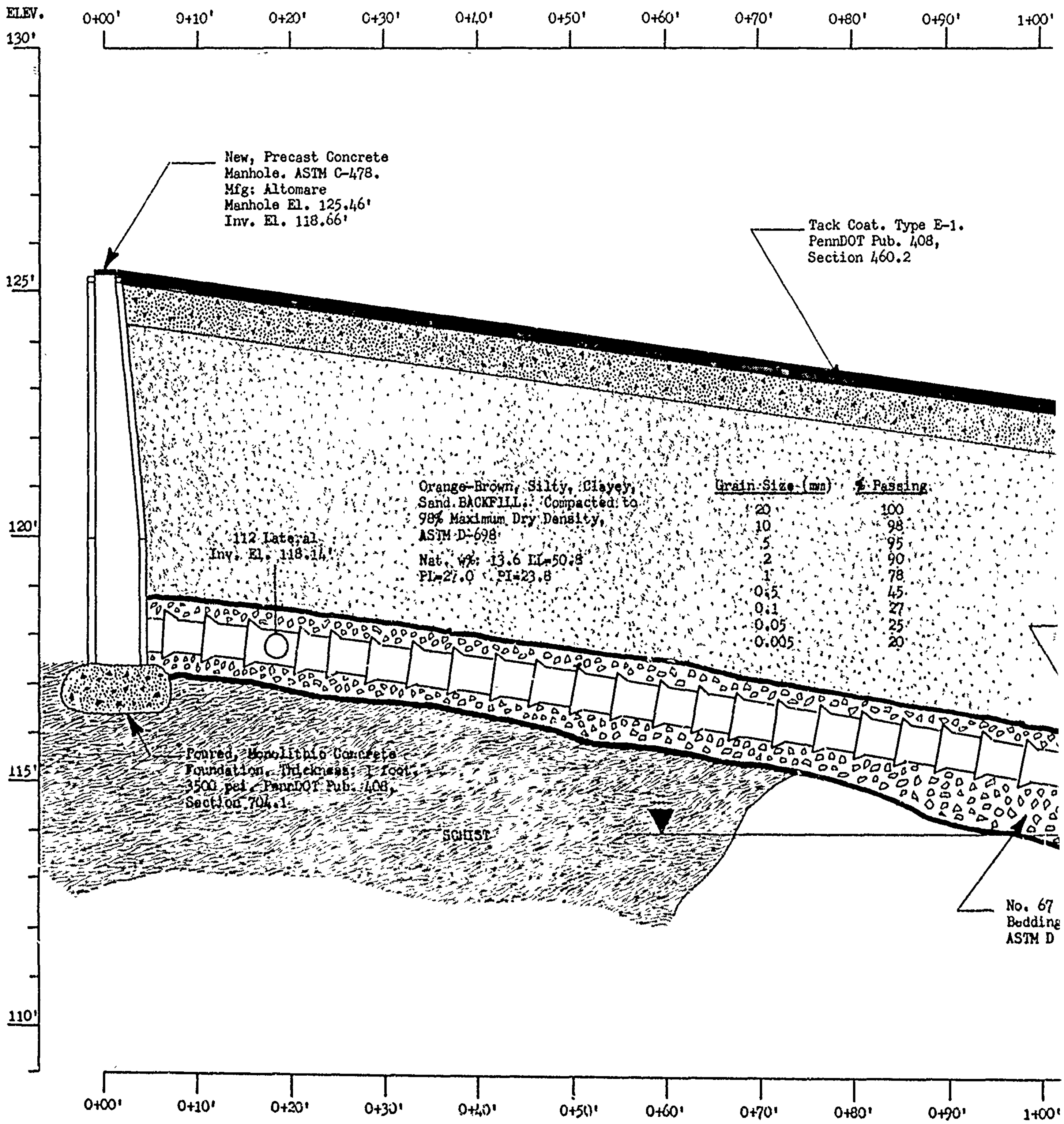
APPENDIX H

AS-BUILT CONSTRUCTION DETAILS

APPENDIX H

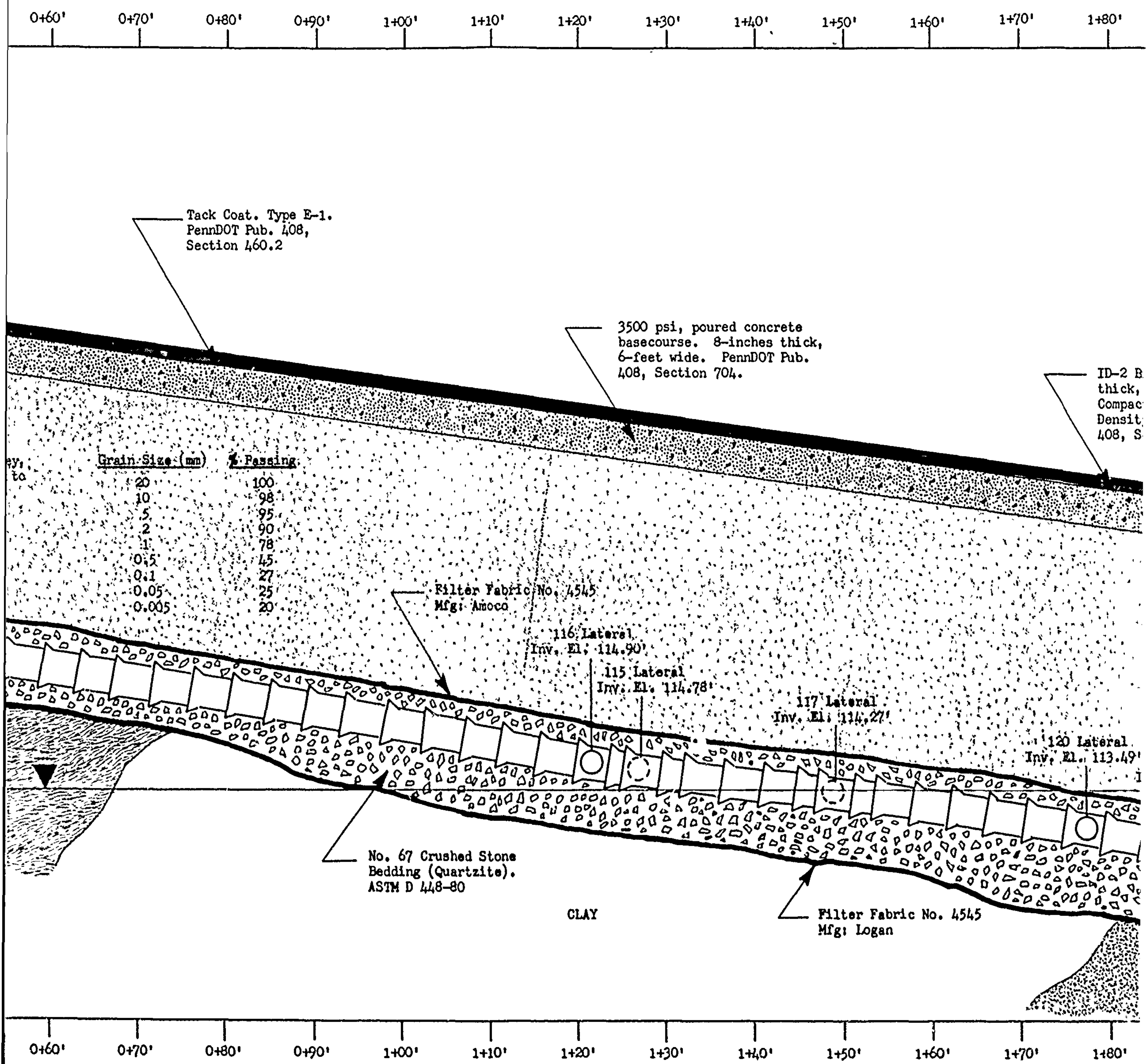
PLAN OF EXCAVATION AND BACKFILL

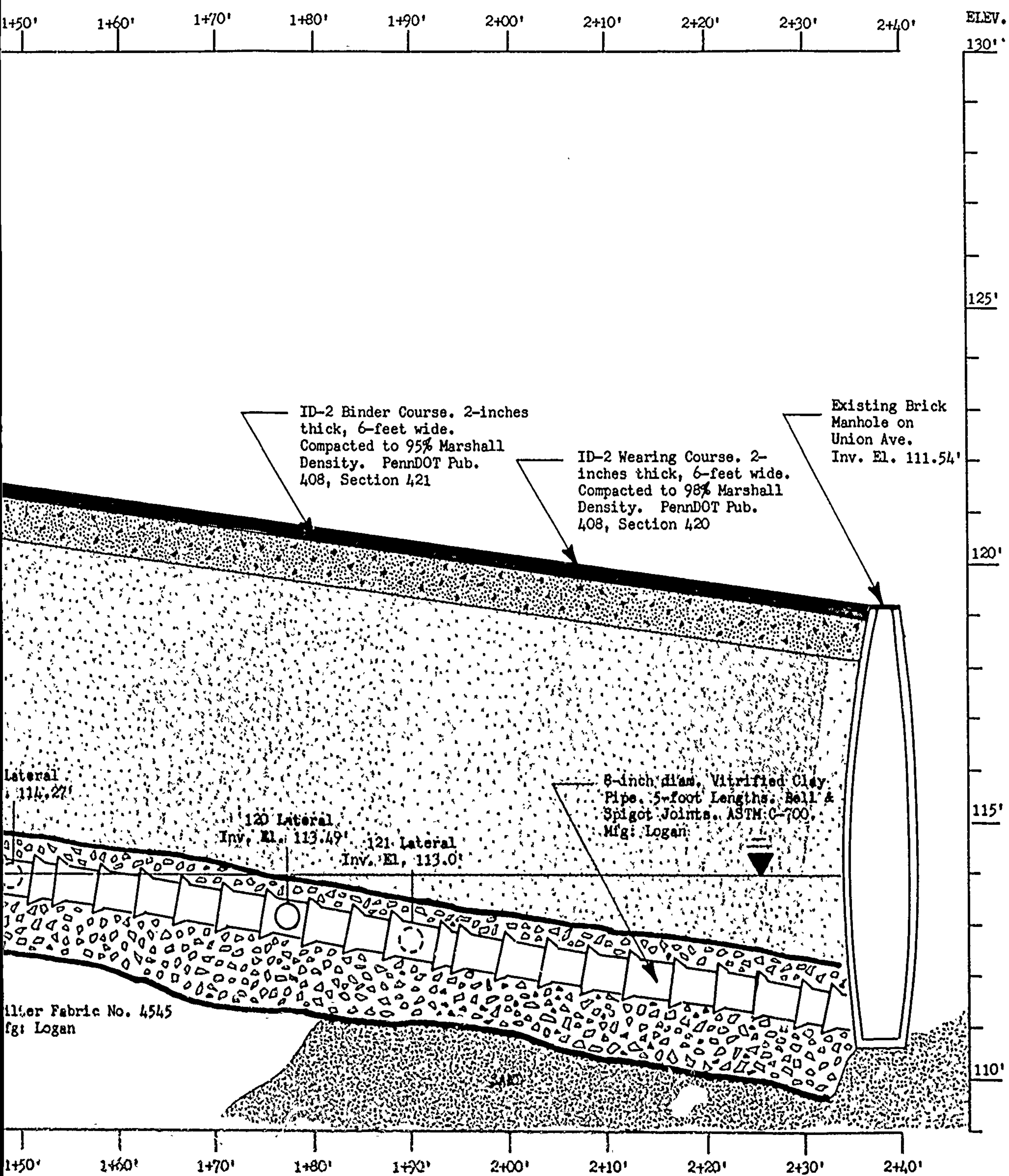




ELEV.
130'
125'
120'
115'
110'
0+00'
0+10'
0+20'
0+30'
0+40'
0+50'
0+60'
0+70'
0+80'
0+90'
1+00'
New, Precast Concrete
Manhole. ASTM C-478.
Mfg: Altomare
Manhole El. 125.46'
Inv. El. 118.66'
Tack Coat. Type E-1.
PennDOT Pub. 408,
Section 460.2
Orange-Brown, Silty, Clayey,
Sand BACKFILL. Compacted to
98% Maximum Dry Density,
ASTM D-698
Nat. W%: 13.6 LL=50.8
PL=27.0 PI=23.8
112 Lateral
Inv. El. 118.14'
Grain Size (mm) % Passing
20 100
10 98
5 95
2 90
1 78
0.5 45
0.1 27
0.05 25
0.005 20
Poured, Monolithic Concrete
Foundation. Thickness: 1 foot,
3500 psi. PennDOT Pub. 408,
Section 704.1
SCHIST
No. 67
Bedding
ASTM D

AS-BUILT CONSTRUCTION DETAIL: E. STRATFORD AVE REPLACEMENT SEWER-LINE

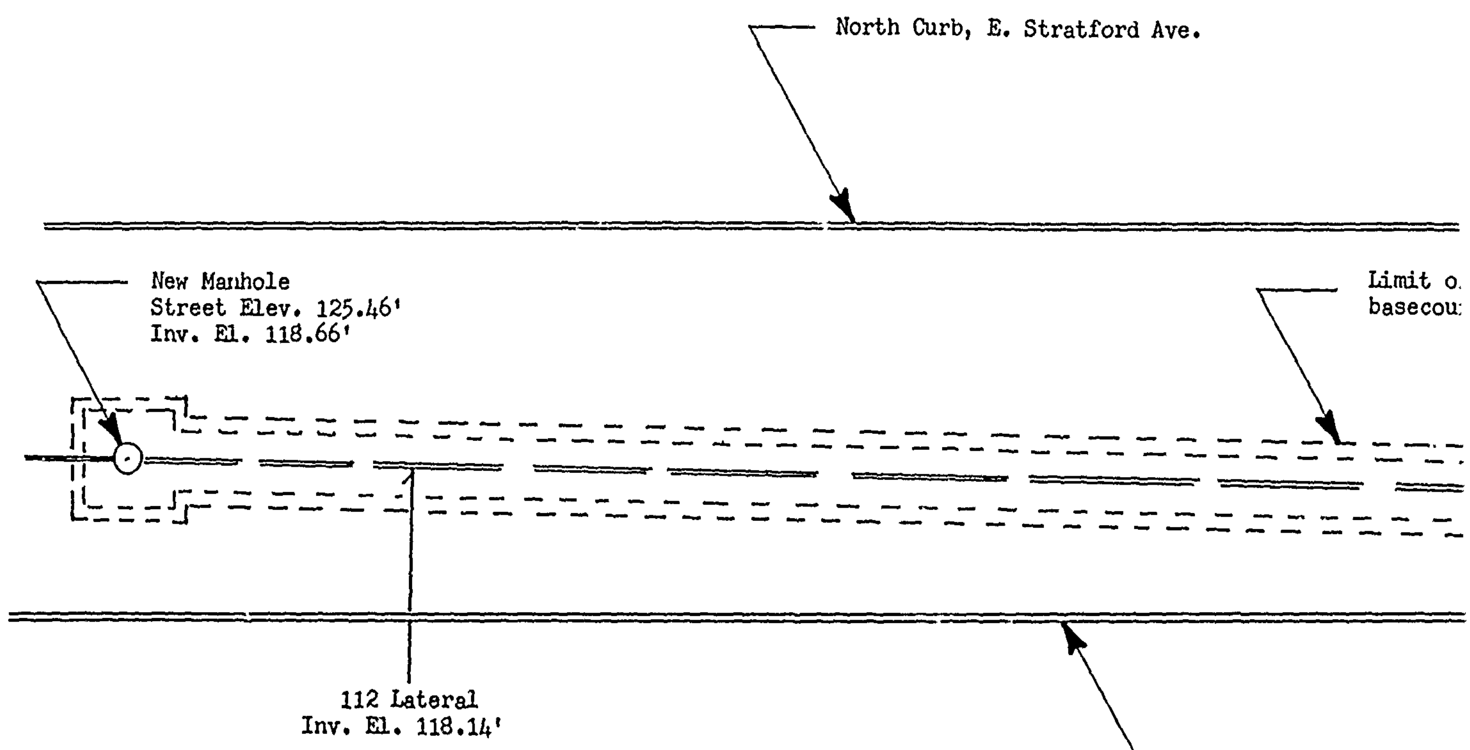




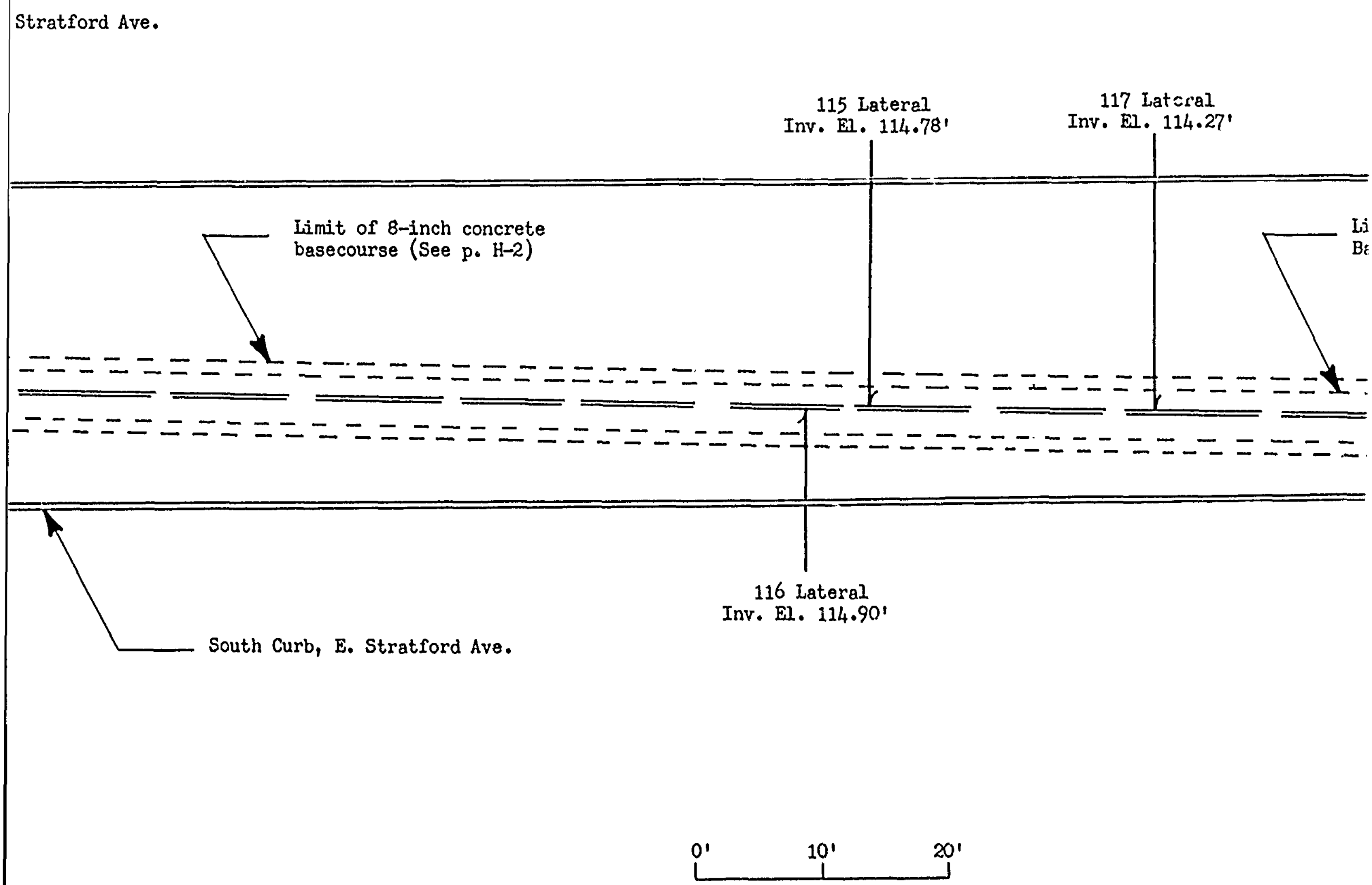
1+50'
1+60'
1+70'
1+80'
1+90'
2+00'
2+10'
2+20'
2+30'
2+40'
ELEV.
130'
125'
120'
115'
110'
ID-2 Binder Course. 2-inches thick, 6-feet wide. Compacted to 95% Marshall Density. PennDOT Pub. 408, Section 421
ID-2 Wearing Course. 2-inches thick, 6-feet wide. Compacted to 98% Marshall Density. PennDOT Pub. 408, Section 420
Existing Brick Manhole on Union Ave. Inv. El. 111.54'
Lateral
114.27'
120 Lateral Inv. El. 113.49'
121 Lateral Inv. El. 113.0'
8-inch diam. Vitrified Clay Pipe. 5-foot Lengths. Bell & Spigot Joints. ASTM C-700. Mfg: Logan
ilter Fabric No. 4545
fg: Logan

H-3 / H-4

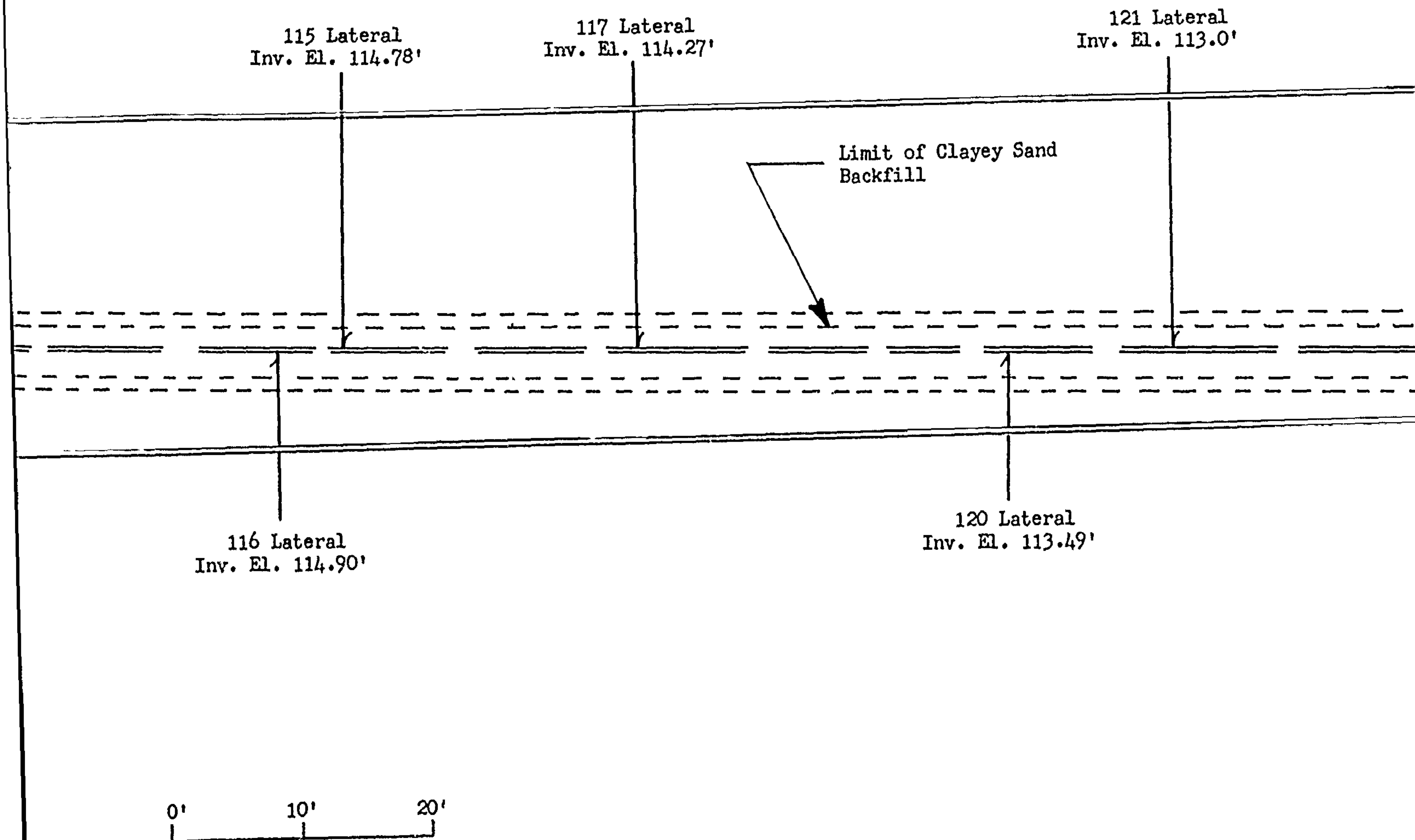
H-


North Curb, E. Stratford Ave.
New Manhole
Street Elev. 125.46'
Inv. El. 118.66'
Limit o
basecou
112 Lateral
Inv. El. 118.14'
South Curb, E. S

AS-BUILT CONSTRUCTION DETAIL (PLAN): E. STRATFORD AVE. REPLACEMENT SEWER-LINE

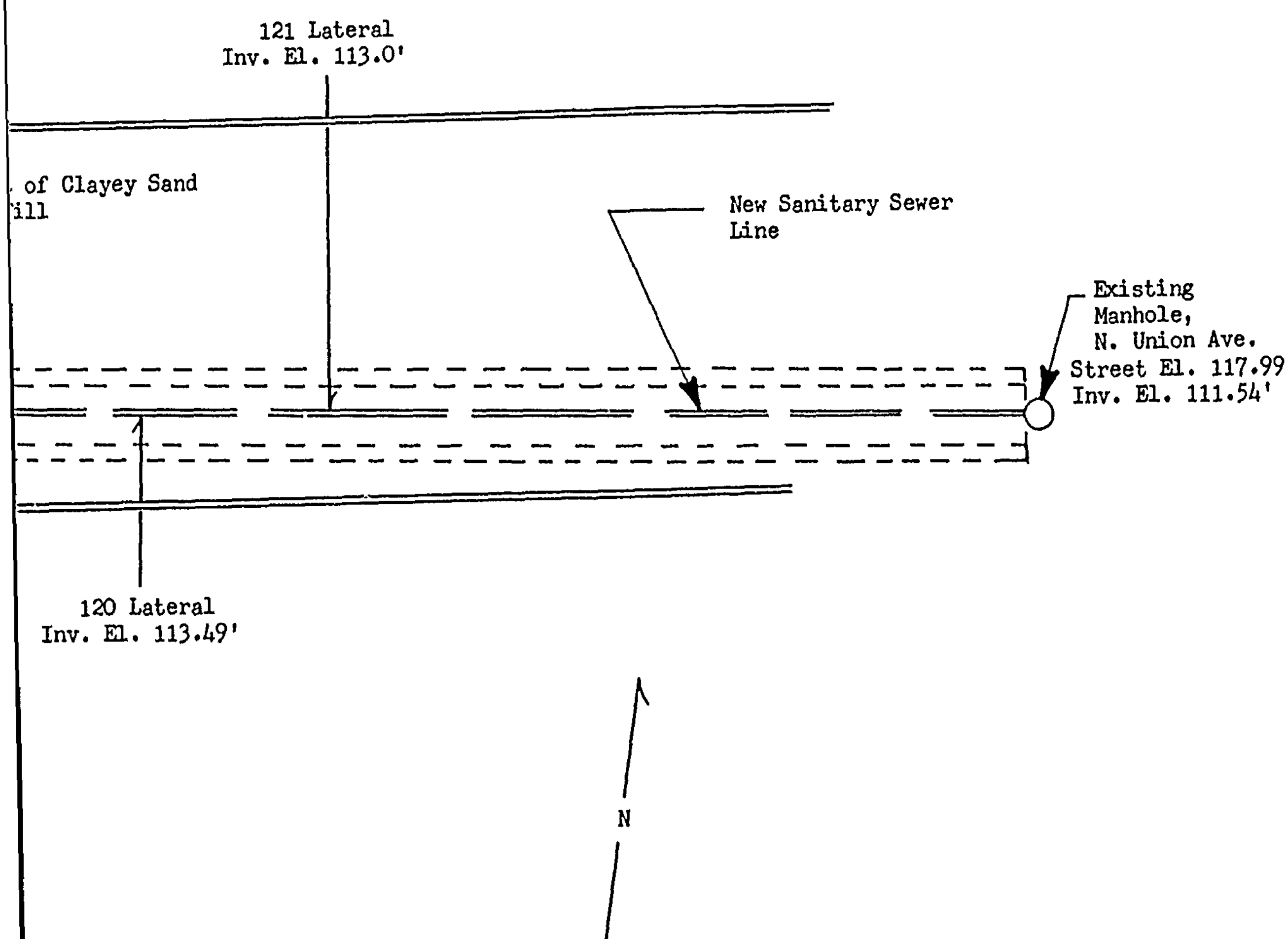


TION DETAIL (PLAN): E. STRATFORD AVE. REPLACEMENT SEWER-LINE



3.

4.


121 Lateral
Inv. El. 113.0'
. of Clayey Sand
'ill
New Sanitary Sewer
Line
Existing
Manhole,
N. Union Ave.
Street El. 117.99
Inv. El. 111.54'
120 Lateral
Inv. El. 113.49'
N

U.S. Army Corps of Engineers
Lansdowne Radioactive Residence Complex
Dismantlement/Removal Project
105-107 East Stratford Avenue
Lansdowne, Pennsylvania 19050
215-622-2350

Memo No. 40
12 April 89

TO: J. Moore

FM: W. Wickboldt

SUBJECT: Proposed Use of Filter Fabric in Construction of E. Stratford Ave. Sewer

1. Groundwater in the sewer excavation has posed the problem of how to lay the sewer pipe and backfill the excavation in the dry. Attemps to dewater with a sump pump only lowered the water level to the bottom of the ditch. When this happens, boils and erosion channels appear in the ditch bottom and the soil develops a quick condition. By the time the bottom of the ditch has been trampled by workers going about their activities of putting in the shoring, etc., the subgrade has been turned into a quagmire unsuited to bed the sewer pipe upon.

2. Mr. Loyd Noll (Penonni Assoc.) has recommended that the Contractor muck out the bottom of the ditch and place a layer of crushed No. 56 stone to provide drainage and a firm layer to bed the pipe. I have also discussed with Mr. Noll the desireability of laying a filter fabric in the bottom of the ditch before laying the crushed rock, and he believes that this is the correct thing to do. The purpose of the filter fabric will be to prevent piping of fines out of the subgrade and into the overlying gravel which would be expected to cause the pipe to settle into the subgrade. If any such settlement were to occur, it would likely be differential settlement, causing the pipe to break at the joints.

3. The attatched sketch shows how the filter fabric would be employed. I consider this to be a practical alternative to more extreme methods of dewatering.

Walter

WICKBOLDT

cc: Huston, CNSI
Noll, Penonni Assoc.

Pennoni Associates Inc.

Engi rs, Surveyors, Planners, Architects
1600 Callowhill Street
Philadelphia, Pennsylvania 19130
215-561-0460
Fax: 215-496-0063

MEMORANDUM

TO: Walter Wickboldt, U. S. Army Corps of Engineers

FROM: Lloyd S. Noll *Lloyd S. Noll*

DATE: April 14, 1989

SUBJECT: Dismantlement/Removal Project
105/107 East Stratford Avenue
Lansdowne, PA

We have reviewed your facsimile transmission of April 12, 1989 regarding the proposed use of filter fabric in construction of the East Stratford Avenue Sewer (your Memorandum No. 40 with attachment).

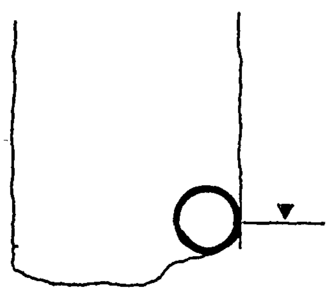
The information presented therein is acceptable with one clarification to be added in Step 8 which is to note that the filter cloth is to be overlapped a minimum of six (6") inches.

We have had several telephone conversations with Mr. Bill Seitz of Carlucci Construction with respect to the filter fabric to be utilized. Based upon information submitted by A.C.F. Inc., the proposed supplier of the geotextile material, we have determined that Amoco Fabrics and Fibers Company Soil Filtration Fabric No. 4545 is acceptable for this installation.

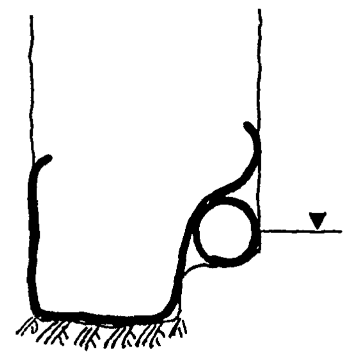
LSN/mcb

cc: R. J. Robinson, 3rd, Borough Manager
George V. Bochanski, Jr., Councilman

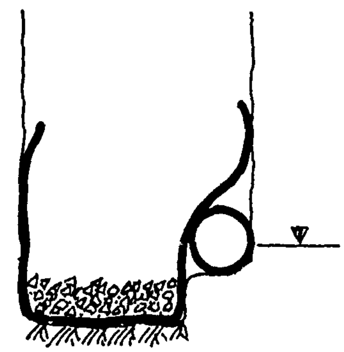
PROPOSED METHOD OF UTILIZING FILTER FABRIC IN COMBINATION WITH CRUSHED STONE TO OVERCOME GROUNDWATER PROBLEMS ASSOCIATED WITH CONSTRUCTION OF THE NEW SEWER ON E. STRATFORD AVE.



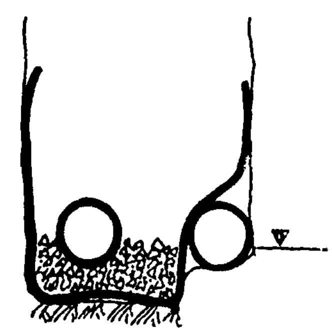
1. Trench is excavated down to old sewer pipe and shored



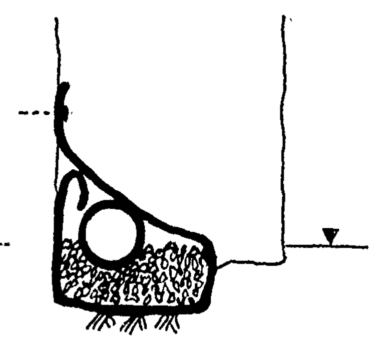
2. Disturbed material is mucked out of trench bottom. Filter cloth is laid.



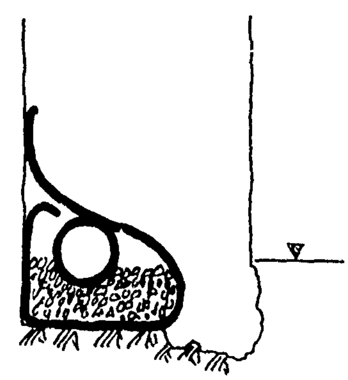
3. No. 56 crushed stone bedding is laid atop filter cloth.



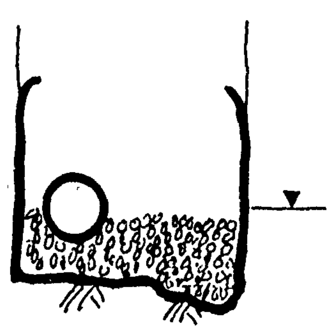
4. New pipe is laid in gravel bed.



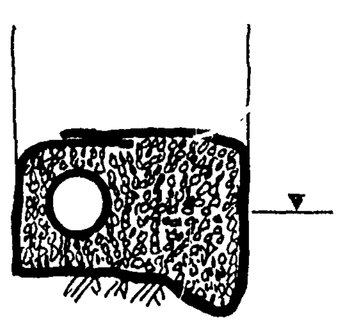
5. Old contaminated pipe is removed.



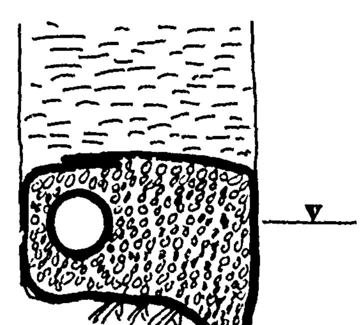
6. Contaminated soil underlying old pipe is removed.



7. Filter cloth is spread over entire ditch bottom and covered with gravel.



8. Gravel layer is poured above the water table and completely draped with filter cloth to provide a dry surface to place backfill on



9. Trench is backfilled.

LANSDOWNE RADIOACTIVE RESIDENCE COMPLEX
DISMANTLEMENT/REMOVAL PROJECT
105/107 East Stratford Avenue
Lansdowne, Pennsylvania 19050

Soil Type Within Sewer Line Excavation

NOTES FOR SEWER EXCAVTION DRAWING

1. New East Stratford Avenue Manhole (starting point), approximate depth to bottom of trench 8 feet, trench bottom dry, weathered rock (schist/gneiss) from bottom of trench to grade level.

2. 70 feet east from new manhole, approximate depth 7 1/2 feet, trench bottom damp with occasional pockets of ground water, weathered rock at bottom of trench overlain with predominately clay mixed with rock to a depth of 1 foot.

3. 78 feet east from new manhole, approximate depth 7 1/2 feet, trench with pockets of ground water, clay at bottom of trench overlain with rock and soil to a depth of 1 foot.

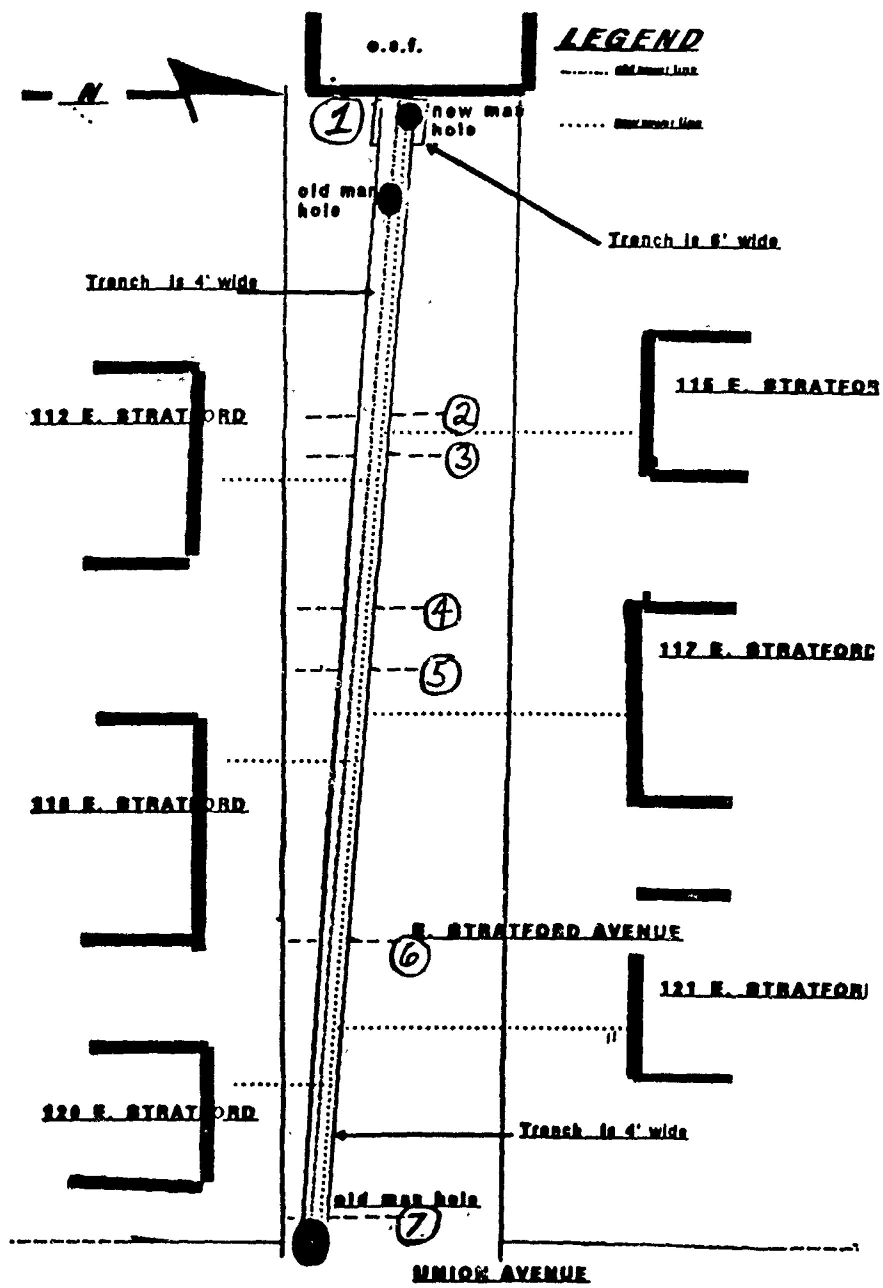
4. 110 feet east from new manhole, approximate depth 7 1/2 feet, trench bottom material saturated with ground water, clay bottom overlain with rock and soil to a depth of 1 foot.

5. 123 feet east from new manhole, approximate depth 7 feet, standing water in bottom of trench, clay bottom overlain with rock and soil to a depth of 1 foot.

6. 180 feet east from new manhole, approximate depth 7 feet, standing water in bottom of trench, clay bottom overlain with clay/sandy soil mixture to a depth of 5 1/2 feet then rock and soil to a depth of 1 foot.

7. 248 feet east, North Union Avenue manhole, approximate depth 6 1/2 feet, standing water in bottom of trench, clay/sandy soil mixture at bottom of trench overlain with rock and soil to a depth of 1 foot.

SOIL TYPE WITHIN SEWER LINE EXCAVATION
(See attached notes for description of soil types associated with numbers)



STRATFORD AVENUE SEWER LINE EXCAVATION LOG
JOHN A. SOYAK, CIH
Site Health & Safety Officer

DATE	TIME	STATUS/SAMPLING RESULTS
4/04/89	0655 - 0725	Temporatry shoring removed from inital excavation at Union Avenue manhole and replaced with permanent shoring according to ACOE specifications provided on 4/03/89. Oxygen content as measured at two points within working zone was 21.8% oxygen and negative LEL for explosive gases.
4/05/89	0645 - 0705	Shoring inspected and sump pump activated to drain water collecting in the trench from ground water intrusion. Oxygen content measured at Union Avenue manhole and 25 feet west of the manhole (work zone). Oxygen content was 21.8% and negative LEL for both sampling positions.
4/06/89	0640 - 0720	Shoring inspected and meets ACOE specifications. Trench received runoff from 0.5 inches rain. Sump pump activated and drain hole established in Union Avenue manhole. Oxygen content measured at Union Avenue manhole, ten feet from manhole, and 45 feet from manhole within the trench. Oxygen content was 21.8% and negative LEL for all sampling positions. Heating oil storage tank from 105 East Stratford Avenue drained (approximately 75 gallons sludge) and oxygen content 21.8% with negative LEL.
4/07/89	0645 - 0705	Shoring inspected and no deficiencies noted. Water level within trench approximately 5 inches and sumb pump activated. Oxygen content measured ten feet and 45 feet from Union Avenue manhole. Oxygen content was 21.8% and negative LEL for both sampling positions. MSA Combustible Gas and Oxygen Alarm, Model 260, received from Mr. Jim Salter, Chem-Nuclear Systems, Inc. which was calibrated on April 4, 1989. Returned site meter to Chem-Nuclear for calibration. Atmosphere in heating oil storage tank measured with 21.8% oxygen and approximately 1% LEL.

STRATFORD AVENUE SEWER LINE EXCAVATION LOG CONTINUED

4/10/89	0645 - 0718	Shoring inspected and ditch jacks replaced 4/07/89 with 4"x4" cross braces every 4.6' approximately two feet below ground surface and two feet above bottom of trench. Approximately 4 - 6" water standing in trench bottom. Oxygen content measured ten feet and 45 feet from Union Avenue manhole. Oxygen content was 21.8% and negative LEL for both sampling positions. Atmosphere in heating oil storage tank measured with 21.8% oxygen and negative LEL.
4/11/89	0635 - 0720	Shoring inspected and trench extended to main gate to the project site. Approximately 3 - 5" water standing in bottom of trench. Oxygen content measured ten feet from Union Avenue manhole and at main gate location. Oxygen content was 21.8% and negative LEL for both sampling positions. Atmosphere in heating oil storage tank measured with 21.8% oxygen and negative LEL.
4/11/89	1030 - 1415	The 105 East Stratford Avenue heating oil storage tank was cut into sections using a pneumatic air chisel. Oxygen content 21.8% with negative LEL inside the tank during the cutting process. Sludge from bottom of tank scraped and placed into a 55 gallon drum. Both 55 gallon drums of waste heating oil to be recycled after radiological sampling for release from the project site.
4/12/89	0635 - 0705	Shoring inspected and trench extended ten feet past main gate. Approximately 3 - 5" standing water in the trench bottom. Oxygen content measured ten feet from Union Avenue manhole and ten feet past main gate. Oxygen content was 21.8% and negative LEL for both sampling positions.
4/13/89	0640 - 0715	Shoring inspected and trench extended 48 feet past main gate. Approximately 3 - 5" standing water in the trench bottom at various locations. Oxygen content measured ten feet from Union Avenue manhole, mid-distance, and at working location within the trench. Oxygen content was 21.8% and negative LEL for the three sampling locations.
4/13/89	1330	The two 55 gallon drums containing approximately 80 gallons of waste heating oil sludge transported off site to The Brake Shop, 448 Long Lane, Upper Darby, PA (Telephone 284-3388) for recycling.

STRATFORD AVENUE SEWER LINE EXCAVATION LOG CONTINUED

4/14/89	0635 - 0657	Shoring inspected and trench extended 55 feet past main gate to just beyond old East Stratford Avenue manhole. Approximately 3 - 5" standing water in the trench bottom at various locations. Oxygen content measured ten feet from Union Avenue manhole, mid-distance, and at the working location near the old manhole. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/17/89	0645 - 0719	Shoring inspected and three areas showed sluffing of earth due to rains (0.8" over the weekend). The areas of sluffing did not affect the intergity of the shoring system and the areas were repaired by 0818. Subsurface water dainage continues in the area approximately 45 feet from the North Union avenue manhole with water discharging into the sanitary sewer. The new sewer line was removed on Friday, 4/14/89, with sections placed upon the lower wooden cross braces until a decision is made by the ACOE on continuation of the new sewer line. Oxygen content measured ten feet from the Union Avenue manhole, mid-distance and at the face of the work location. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/18/89	0635 - 0715	Shoring inspected and new cloth blanket with crush stone providing excellent drainage. The surface of the trench bed is dry and the relayed sewer line appears to meet ACOE specifications. The relayed sewer line extends to the gate of the project site from the North Union Avenue manhole. Oxygen content measured ten feet from the Union Avenue manhole, mid-distance and at the face of the work location. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/19/89	0700 - 0730	Shoring inspected and the relayed sewer line extends to the new East Stratford Avenue manhole location. Rain during the past 24 hours was 0.1 inches and the trench bed is dry due to the crushed stone and cloth blanket. Oxygen content measured ten feet from the Union Avenue manhole, mid-distance and at the new East Stratford Avenue manhole location. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/20/89	0641 - 0709	Shoring inspected and approximately 15 feet of the old sewer line has been removed starting from the new East Stratford Avenue manhole and proceeding east to the North Union Avenue manhole. Concrete base for the new manhole poured. Trench bottom dry and shoring meets ACOE specifications. Oxygen

		content measured ten feet from the Union Avenue manhole, mid-distance and at the working location. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/21/89	0635 - 0658	Shoring inspected and soil remediation continuing along path of the old sewer line proceeding east to the North Union Avenue manhole. Oxygen content measured ten feet from the Union Avenue manhole, working location, and at the East Stratford Avenue new manhole. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/22/89	0646 - 0710	Shoring inspected and soil remediation completed up to the ACOE Trailer. New sewer line covered with crushed stone and cloth blanket placed over the line up the ACOE Trailer. Oxygen content measured ten feet from the Union Avenue manhole, working location, and at the East Stratford Avenue new manhole. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/24/89	0640 - 0700	Shoring inspected and soil remediation completed to 117 East Stratford Avenue. Sewer line covered with crushed stone and cloth blanket at end of day's activities. Oxygen content measured ten feet from the Union Avenue manhole, wortking location, and at the East Stratford Avenue new manhole. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/24/89	1500 - 1625	Oxygen content and LEL continously monitored within North Union Avenue manhole during removal of old sewer line connection and repair of the opening into the manhole base. Oxygen content was 21.8% and negative LEL during the operation.
4/25/89	0640 - 0705	Shoring inspected and soil remediation completed to the North Union Avenue Manhole. Remaining sewer line covered with crushed stone and cloth blanket at end of day's activities. Oxygen content measured ten feet from the Union Avenue manhole, working location, and at the East Stratford Avenue new manhole. Oxygen content was 21.8% and negative LEL for all three sampling locations.
4/25/89	0800 - 1700	Shoring removed and trench backfilled with soil in 18" lifts. Each lift compacted prior to new lift being placed within the trench.
4/25/89	1700	Log complete.

APPENDIX I

SAMPLE PHASE HAZARD ANALYSIS USED ON THE LANSDOWNE PROJECT

APPENDIX I

The Phase Hazard Analysis presented in the Appendix is typical of any of the 26 PHA's written for undertaking different work activities over the course of the Lansdowne Project. It sets forth, in detail, how the work activity is to be performed. This was done to aid in identifying any potential hazards that would be faced therefrom. The PHA concludes by specifying safety procedures and protective clothing and equipment to either eliminate the hazard or make the risk acceptable.

LANSDOWNE RADIOACTIVE RESIDENCE COMPLEX
DISMANTLEMENT/REMOVAL PROJECT
LANSDOWNE, PENNSYLVANIA 19050

PHASE HAZARD ANALYSIS

March 1, 1989

PROJECT PHASE: U.S. Army Corps of Engineers Exploratory Soil Testing

These Operations Consist of the Following:

1. Purpose.

a. U.S. Army Corps of Engineers, Baltimore District, personnel under technical direction from Argonne National Laboratory and logistical support from Chem-Nuclear Systems, Inc. shall conduct soil borings for subsurface radioactive contamination during the period March 7 - 10, 1989. These borings shall initially be made through the street pavement on the west side of North Union Avenue between East Stewart Avenue and East Stratford. Additional borings may be conducted depending upon the results of the initial tests. These additional borings may be conducted on private property at the following locations: 117 and 121 East Stratford Avenue.

b. The drilling operation is for the recovery of soil samples for radiological analysis to determine if Radium-226 concentration exceeds 5 pCi/gram in soil above the local natural background concentration. A radiological anomaly was detected in this area during preliminary surveys conducted on February 17 - 23, 1989. This anomaly was detected when a gamma scintillation probe was passed through the Union Avenue sanitary sewer indicating elevated levels of radioactivity in the Radium and Potassium spectral ranges. The Union Avenue sewer line in question is located approximately 150 feet down hill from the Lansdowne Radioactive Residence Complex Dismantlement/Removal Project at a depth of approximately 10 feet. This zone of increased radioactivity may be a natural soil phenomena or radiological contamination which has migrated from the project site over the years.

2. Background.

a. Boring locations shall be accessible with the truck mounted drill rig. Natural gas, potable water, and an 8 inch sewer line are located in the vicinity of drilling locations. There are also overhead electrical

lines near these drilling locations. The lowest electrical line is approximately 15 feet above street level running along the curb line. Drilling sites are located directly on North Union Avenue and the truck mounted drill rig shall be parked parallel to the overhead electrical lines. Additional drilling locations could possibly include the adjoining sidewalk and private properties.

b. The area is underlain by sandy, residual soil derived from the weathering of underlying schist and gneiss. The soil grades downward into fresh rock through a saprolite zone. Depth to unweathered rock is irregular. In some places, it may be as little as 12 feet deep. Large, unweathered boulders are frequent in the soil. Depth to groundwater is unknown, but it is unlikely that it would be encountered above a 12 feet depth.

3. Subsurface Investigation Procedures.

a. A U.S. Army Corps of Engineers' truck mounted drill rig with support vehicles and personnel shall be initially positioned on the west side of North Union Avenue with the front of the truck heading south into oncoming traffic. Water in support of drilling operations may be obtained from a garden hose at the project site for filling the water trailer.

b. The initial locations for the drilling operations shall be established by Argonne National Laboratory personnel and marked with red paint prior to the arrival of the drilling crew.

c. Holes shall be drilled to a depth of approximately 12 feet. However, deeper drilling may be required in the following instances:

(1) To prevent any hole from terminating in a radioactively contaminated substratum.
(2) To locate subsurface contamination which may be detected at the bottom of the drill hole with the gamma scintillation probe.
(3) To determine the depth of ground water in the drilling location.

The soil sample diameter shall be no less than 3 inches. The number of holes to be drilled is dependent upon the initial soil radiological sampling results. The U.S. Army Corps of Engineers onsite representative shall make the final decision of the depth of each drill hole in coordination with Argonne National Laboratory.

d. An appropriate drilling tool shall be used when drilling through the pavement on North Union Avenue. A water trailer shall be provided by the U.S. Army Corps of Engineers to support drilling operations which require water as a drilling lubricant. Drilling water may not have to be retained when initially drilling through the top surface of the pavement on North Union Avenue. If boulders impede the soil sampling operation and must be cored through in order to advance the soil sampler, the hole shall be cased and a mud pan set in place at the top of the hole to contain any drilling water extruded from the hole. This drilling water will be siphoned/pumped from the mud pan into a B-25 Box located near the truck mounted drill rig. Drilling water will not be recirculated into the bore hole. The drilling water shall be retained within the B-25 Box until it has been certified as releaseable by the Chem-Nuclear Site Health Physicist and confirmed by Argonne National Laboratory in accordance with the criteria established within 10 CFR 20 Appendix B and the Project Spill Control Plan (Reference: Phase Hazard Analysis, August 31, 1988, Waste Water Discharge to Sanitary Sewer). Any sludge generated will be retained and relocated to the project site for processing as either radiological or nonradiological waste.

e. Soil samples shall be surveyed by Argonne National Laboratory with a PG 2 detector while still in the sampler prior to being placed into U.S. Army Corps of Engineers' wooden sample boxes. Depths at the top and bottom of each soil sample row within the box shall be labeled. The depth at the bottom of each drive of the soil sampler shall be marked with a wooden block inside the box and labeled. The outside of each soil sample box shall be labeled on the top and bottom ends with the name of the project, date, hole number, box number and depth interval represented by each sample. The sample boxes shall be placed into the custody of Argonne National Laboratory for radiological analysis after the core box has been logged and photographed by the drilling crew inspector. Copies of the driller's log for each hole shall be turned over to Argonne National Laboratory prior to

the drill crew leaving the project site. Whenever a soil sample is removed from a box, it will be done in the presence of the inspector, and the inspector will place a styrofoam block inside the box marking the spot where the sample was removed.

f. The truck mounted drill rig with associated equipment shall access potential sidewalk and lawn drilling locations by driving on 1/2 to 3/4 inch plywood sheets to prevent damage to private property. The U.S. Environmental Protection Agency is responsible for coordinating drilling activities on private property. Prior to drilling through lawn area, the sod shall be removed and stored in order to restore the site to its original condition. In addition, 6-mil polyethylene sheeting shall be placed over the immediate drilling area by U.S. Corps of Engineer personnel and covered with plywood in order to prevent potential contamination of the ground surface. The polyethylene sheeting, plywood and any other materials necessary to support the onsite drilling operations may be procured for the U.S. Army Corps of Engineers by Chem-Nuclear Systems, Inc.

g. The truck mounted drilling rig shall not be set up or moved off of a drilling site without the approval of the Chem-Nuclear Systems, Inc. Site Supervisor. The Site Supervisor must be present during any movement of the truck mounted drilling rig. The Site Supervisor shall also be responsible for directing the placement and ensuring the adequacy of all ground protective devices in order to minimize potential property damage during the movement of the truck mounted drill rig over private properties. After all preparations have been completed for each drilling location, the U.S. Army Corps of Engineers onsite representative shall be notified by the Site Supervisor that the drilling site is ready for his inspection. No drilling activity shall be performed at any location without the direct approval of the U.S. Army Corps of Engineers onsite representative.

h. Sufficient numbers of soil samplers shall be provided by the U.S. Army Corps of Engineers so that work is not impeded due to radiological measurements. Each sampler must be surveyed prior to reuse by the supporting Chem-Nuclear RADCON technician. If a sampler is found contaminated, it shall be decontaminated by U.S. Army Corps of Engineer personnel and certified clean by the RADCON technician prior to being reused during the drilling operations.

PHASE HAZARD ANALYSIS

LOCATION: Lansdowne, PA Date: March 1, 1989

PROJECT PHASE: U.S. Army Corps of Engineers Exploratory Soil Testing

i. Each drill hole shall be surveyed by Argonne National Laboratory using a gamma scintillation probe to determine the level of radioactivity in the Radium and Potassium spectral ranges.

j. Drill holes in lawn areas shall be backfilled with clean earth, compacted and the surface restored to its original condition. Holes drilled in North Union Avenue and any sidewalks shall be backfilled to the surface with "K-Crete" bag mix with an approximate load bearing rating of 1,000 pounds per square inch using a high slump mix to ensure good flow to the bottom of the drill hole (Personal Communication, February 27, 1989, between Mr. Frank Peel, CNSI Site Supervisor with Mr. Lloyd Noll, Borough of Lansdowne Engineer).

k. The potentially contaminated areas of the truck mounted drill rig and all supporting equipment shall be surveyed by the RADCON technician at the end of each days activities, decontaminated by U.S. Army Corps of Engineers personnel as directed by the RADCON technician and parked after 1645 hours within the fenced administrative area of the project site. All U.S. Army Corps of Engineers vehicles and equipment parked inside of the administrative area of the project site shall be removed by 0700 hours each day so as not to impede Chem-Nuclear Systems, Inc. operations.

l. Daily verbal preliminary results and the final written Argonne National Laboratory report shall be provided by the U.S. Army Corps of Engineers onsite representative to the Chem-Nuclear Systems, Inc., Project Manager in order to accommodate any potential impacts on the project schedule.

SAFETY REQUIREMENTS

A) The names and social security numbers of the U.S. Army Corps of Engineers personnel associated with the drilling operation shall be provided to the Site Health & Safety Officer prior to arrival at the project site.

B) Temporary security badges shall be issued to the U.S. Army Corps of Engineers personnel on a daily basis by the Security Guard. One of the individuals shall also be issued a thermoluminescent dosimeter (TLD) to be worn at all times during the drilling operations.

PHASE HAZARD ANALYSIS

LOCATION: Lansdowne, PA Date: March 1, 1989
<u>PROJECT PHASE</u>: U.S. Army Corps of Engineers Exploratory Soil Testing

C) Any U.S. Army Corps of Engineers' portable containers filled with gasoline or other flammable liquids shall be placed within the project site's fuel storage area at the end of each days activity.

D) Potentially contaminated areas of the truck mounted drill rig and all associated equipment shall be surveyed by the RADCON technician prior to leaving each drill site. All soil removed during the drilling operation which is not utilized for radiological analysis shall be stored upon 6-mil polyethylene sheeting and surveyed by the RADCON technician prior to removal from each drilling site. If the soil is found contaminated, it shall be placed within a B-25 Box at the project site for disposal in accordance with the Radioactive Waste Management Disposal Plan.

E) Traffic control shall be established through the employment of a U.S. Army Corps of Engineers flagperson wearing a reflective vest while the truck mounted drill rig is placed into position on North Union Avenue and each time the drill rig is repositioned. The truck mounted drill rig shall be positioned on North Union Avenue facing south so that the front of the vehicle is facing oncoming traffic. Traffic cones shall be positioned so as to warn oncoming traffic in sufficient time that the traffic lane is blocked. Coordination with the Lansdowne Police Department (623-0701) shall be established by the Site Health & Safety Officer prior to each days drilling activity on North Union Avenue.

F) All underground gas, potable water and sewer lines shall be marked prior to any drilling operations. The Chem-Nuclear Systems, Inc. Site Supervisor shall coordinate this operation with the various utility companies. In case of emergency, the following notifications shall be made by the Site Health & Safety Officer: Philadelphia Gas and Electric Company (494-5121), Philadelphia Suburban Water Company (525-7300), and the Borough of Lansdowne Engineer, Mr. Lloyd Noll (563-0460), for any problems associated with the North Union Avenue sewer line.

G) First aid treatment to include all scratches, cuts, and abrasions which break the skin surface shall be immediately evaluated by the site Emergency Medical Technician. The RADCON technician shall monitor the affected area for contamination. The Chem-Nuclear Site Health Physicist must inspect the affected area prior to the individual returning to the work area.

PHASE HAZARD ANALYSIS

LOCATION: Lansdowne, PA   Date: March 1, 1989

PROJECT PHASE: U.S. Army Corps of Engineers Exploratory Soil Testing

PERSONNEL INVOLVED WITH OPERATION:

A)____________________________________ DATE:________

B)____________________________________ DATE:________

C)____________________________________ DATE:________

D)____________________________________ DATE:________

E)____________________________________ DATE:________

F)____________________________________ DATE:________

G)____________________________________ DATE:________

H)____________________________________ DATE:________

I)____________________________________ DATE:________

J)____________________________________ DATE:________

K)____________________________________ DATE:________

L)____________________________________ DATE:________

M)____________________________________ DATE:________

N)____________________________________ DATE:________

O)____________________________________ DATE:________

P)____________________________________ DATE:________

PHASE HAZARD ANALYSIS

LOCATION: Lansdowne, PA Date: March 1, 1989

PROJECT PHASE: U.S. Army Corps of Engineers Exploratory Soil Testing

H) Chem-Nuclear Systems, Inc. shall provide radiological and safety oversight for the drilling operations and any violations shall be reported immediately to the U.S. Corps of Engineers onsite representative for corrective action. Personal decontamination and protective clothes washing facilities shall be available to U.S. Army Corps of Engineers personnel within the Crew Trailer on the project site.

I) A "Confined Space Entry Permit" shall be required prior to any personnel entering a sanitary sewer manhole. The Site Health & Safety Officer shall prepare a separate Phase Hazard Analysis Addendum as required to cover these entry activities.

J) U.S. Army Corps of Engineers personnel involved with the drilling operation shall wear as a minimum the following personal protective devices: A, C, E, F with H, K with attached full faceshield, and Q as required for hearing protection. Rainsuits shall be worn by U.S. Army Corps of Engineers personnel during periods of inclement weather.

PERSONAL PROTECTIVE DEVICES REQUIRED:

A) Work Coveralls	B) Tyvek Coveralls	C) Safety Boots/Shoes
D) Plastic Boots	E) Rubber Boots	F) Cotton Gloves
G) Leather Palm Gloves	H) Rubber Grip Gloves	I) Safety Glasses
J) Safety Goggles	K) Hard Hat	L) Full Face Resp.
M) Racal Airstream Helmet	N) 1/2 Face PAPR	O) Full Face PAPR
P) Dust Mask	Q) Ear Plugs	R) Life Line/Harness

RECOMMEND APPROVAL:

SITE HEALTH AND SAFETY OFFICER: [signature] DATE: 3-1-89

SITE HEALTH PHYSICIST: [signature] DATE: 3-1-89

PROJECT MANAGER: [signature] DATE: 3-1-89

APPROVED BY:

C.O.E. REPRESENTATIVE: Walter Wickbold DATE: 3-1-89

APPENDIX J

CERTIFICATES OF CONFORMANCE

APPENDIX J

SUMMARY OF CERTIFICATES OF CONFORMANCE

Item	Supplier	Conformance Standard	Page
Precast Concrete Manhole	Altomare	PennDOT Pub. 408, Section 713.2 (C)	J-3
ID-2 Binder Course	Mantus	PennDOT Pub. 408, Section 421.1	J-4
VCP Pipe Fittings	Logan	ASTM-C-700-86	J-5
VCP Sewer Pipe	Logan	ASTM-C-700	J-6
ID-2 Wearing Course	Mantus	PennDOT Pub. 408, Section 420.2	J-7
Class A Base Course Concrete	Suburban	PennDOT Pub. 408, Section 704	J-8

J-3

CH 7-0841
AD 3-5492

Philip N. Altomare

SEWER BRICK AND PRECAST CONTRACTOR
1804 GRAVERS ROAD
NORRISTOWN, PA. 19401

ESTIMATING
SEWERS

CARLUCCI CONSTRUCTION COMPANY
P.O. BOX 189
LANSDOWNE, PA. 19050

APRIL 4, 1989

GENTLEMEN:

This letter is to certify that the precast concrete manhole delivered to 105 East Strateford Avenue, meets requirements of PA. DOT Publication 408, Section 713.2 (C) and Publication Section 709.3 in all areas except for top opening which meets requirements for the City of Philadelphia Water Department.

Sincerely,

Nick Altomare

Nick Altomare

cc/na

DAILY BITUMINOUS CERTIFICATION

NOTICE OF SHIPMENT

THE FOLLOWING COVER SHIPMENT (S) OF:

WEARING COURSE (TYPE) ________ (SRL) ________ TONS ________ DATE SHIPPED ________

BINDER COURSE (TYPE) ID-2B (SRL) Binder TONS 20.12 DATE SHIPPED 6-8-89

BCBC MATERIAL (TYPE) ________ (SRL) ________ TONS ________ DATE SHIPPED ________

PLANT GLASGOW INC FREEBORN PLANT

LOCATION SPRINGFIELD DEL CO

ASPHALT BILL OF LADING NUMBER AC20 #18040 SUPPLIER Mantua Oil Co.

________ PADOT ________ P.O. NUMBER ________

✓ CONTRACTOR James Cunningham L.R.&SECTION Lansdowne Ave

________ MUNICIPALITY ________ COUNTY Delaware

TYPE OF MAT'L	% AC	PASS # 8	PASS #200	STABILITY	FLOW	VOID	AVG,FLD DEN
ID2 Binder	4.4	36.0	3.5	1660	10.4	3.5	156.3 lb/cft

REMARKS; Virgin Material

I HEREBY CERTIFY THAT THE MATERIAL AS LISTED ABOVE SHIPPED ON THIS DATE CONFORMS FULLY WITH THE SPECIFICATION REQUIREMENTS OF THE PENNA DEPT OF TRANSPORTATION, OUR RECORDS OF SUPPLY, ATTESTING TO THIS STATEMENT, ARE OPEN FOR INSPECTION BY DEPARTMENT PERSONNEL.

DATE CERTIFIED 6-8-89 CERTIFIED BY: Craig Bucletti

TITLE Technician

SIGNATURE OF COMPANY OFFICIAL

DATE CERTIFIED ________ RECEIVED BY ________

SIGNATURE OF PENN DOT OFFICIAL

3-5

LOGAN

MEMBER NCPI

The Logan Clay Products Co.

P. O. BOX 898 · LOGAN, OHIO 43138 · Area Code 614 385-2184

For your convenience, use our
Toll-Free Direct WATS Lines
Ohio Customers 1 - 800 - 282-5629
Out-of-State Customers 1 - 800 - 848-2141

DATE April 18, 1989

Gentlemen:

This is to certify that the vitrified clay sewer pipe and fittings furnished by The Logan Clay Products Company of Logan, Ohio, through the account of Carlucci Construction Co.

for their job at Lansdowne Project

is manufactured in accordance with and will conform to ASTM Specification C 700-86 Extra Strength.

Sincerely,

Richard H. Holl

Richard H. Holl
- President

STATE OF OHIO }
COUNTY OF HOCKING } SS:

The above statement signed and sworn to in my presence on this 19th day of April, 1989.

Jane Ann Wieland
Notary Public, State of Ohio
My Commission Expires Aug 27, 1993

first TO GUARANTEE
LOGAN KING SIZE VITRIFIED PIPE · FIRE CLAY FLUE LINERS · WALL COPING.

TR-481 (1-72)

- [ ] CEMENT CONCRETE CULVERT PIPE
- [ ] CEMENT CONCRETE CRIBBING
- [ ] CEMENT CONCRETE POROUS UNDERDRAIN
- [ ] CEMENT CONCRETE SLOPE WALL BLOCK
- [ ] TILE UNDERDRAIN
- [X] VITRIFIED CLAY PIPE
- [ ] OTHERS

SUBJECT: Notice of Shipment of

TO: District Engineer
Superintendent

FROM:

The following covers a shipment of Vitrified Clay Pipe from the A-1 Pipe Inc., located at 8471 Hegerman St. Phila, PA

Date Shipped 3-17-89 Destination 105 E. Stratford Ave.

Consigned to P.D.T. Sup't. ______ P. O. Number ______
OR
Contractor Carlucci Const. Co. Route & County Lansdowne,PA

CLASS, TYPE MARKINGS	DATE MADE	DIAMETER INCHES	LENGTH FEET	NUMBER SECTIONS	TOTAL FEET
O-Ring	1989	8" ES Pipe	5'	25	250'

I hereby certify that the material shipped as listed above conforms fully with the specification requirements of the Pennsylvania Department of Transportation.

Signed Pat Sume

QUALITY CONTROL TECHNICIAN
TITLE

Date ______ Approved by: WH
ENGINEER OF TESTS

DAILY BITUMINOUS CERTIFICATION

NOTICE OF SHIPMENT

THE FOLLOWING COVER SHIPMENT (S) OF:

WEARING COURSE (TYPE) 102 (SRL) H TONS 57.53 DATE SHIPPED 6-9-8

BINDER COURSE (TYPE) ________(SRL)________TONS________DATE SHIPPED________

BCBC MATERIAL (TYPE) ________(SRL)________TONS________DATE SHIPPED________

PLANT GLASGOW INC FREEBORN PLANT

LOCATION SPRINGFIELD DEL CO

ASPHALT BILL OF LADING NUMBER AC20 #18040 SUPPLIER Marcita Oil Co

________PADOT________P.O. NUMBER________

✓ CONTRACTOR James Cunningham L.R.&SECTION Lansdowne Ave

________MUNICIPALITY________COUNTY Delaware

TYPE OF MAT'L	% AC	PASS # 8	PASS #200	STABILITY	FLOW	VOID	AVG,FLD DE
102 Wearing	5.3	43.0	5.0	1733	11.8	3.8	151.9 [illegible]

REMARKS; Virgin Material

I HEREBY CERTIFY THAT THE MATERIAL AS LISTED ABOVE SHIPPED ON THIS DATE CONFORMS FULLY WITH THE SPECIFICATION REQUIREMENTS OF THE PENNA DEPT OF TRANSPORTATION, OUR RECORDS OF SUPPLY, ATTESTING TO THIS STATEMENT, ARE OPEN FOR INSPECTION BY DEPARTMENT PERSONNEL.

DATE CERTIFIED 6-9-89 CERTIFIED BY: Craig Bulettie

TITLE Technician

SIGNATURE OF COMPANY OFFICIAL

DATE CERTIFIED ________ RECEIVED BY ________

SIGNATURE OF PENN DOT OFFICIAL

9/14/89

(215) 583-4478 #14 B139112

SUBURBAN MATERIALS CO.
BUILDING MATERIALS
OAK LANE and B. & O. R. R., GLENOLDEN, PA. 19036.

CUST. JOB NO.
DATE 4/26/89 198
NAME Carlucci Construction
ADDRESS 105 East Stafford Ave
CITY & STATE [illegible]
TIME STARTED
TIME RETURN
TIME STARTED
TIME RETURN
DRIVER
PHONE NO. 622-2137

QUANTITY	DESCRIPTION	PRICE	AMOUNT	
	CEMENT			
	LIME			
	MORTAR CEMENT			
	STRUCT-LITE			
	PLASTER PARIS			
	ROCKLATH			
	SAND			
	STONES			
	FLUE LINE			
	BRICK			
	BLOCKS			
	METAL LATH 3500 psi			
18	CU. YARDS OF CONCRETE		972	00
	1030 added [illegible]			
		SUB TOTAL	972	00
SPECIAL INSTRUCTIONS		TAX	58	32
Rec'd By X Bill Seitz Jr.		TOTAL	1030	32

ALL PRICES ARE FOR STREET CURB DELIVERY. WE WILL ASSUME NO RESPONSIBILITY WHEN DELIVERY IS MADE INSIDE OF CURB. TERMS: 2% - 10 DAYS; NET - 30 DAYS. A SERVICE CHARGE OF 1½% PER MONTH WILL BE BILLED ON PAST DUE ACCOUNTS.

APPENDIX K

RECOMMENDED HEALTH-PHYSICS TRAINING FOR PROJECT MANAGEMENT PERSONNEL WORKING ON THE REMEDIATION OF RADIOACTIVE SITES

Applied Health Physics

Presented by Oak Ridge Associated Universities, Oak Ridge, Tennessee
April 9–May 11, 1990, and September 10–October 12, 1990

INTRODUCTION

The use of radiation in industry, medicine, and education has created a need for persons trained in the principles of radiation protection. To meet this need, Oak Ridge Associated Universities will conduct a 200-hour *Applied Health Physics* course.

DESCRIPTION

This intensive training course consists of lectures, laboratory exercises, and tours of nuclear facilities. Students spend approximately 40% of their time performing laboratory exercises using state-of-the-art radiation detection and measurement equipment. Laboratory exercises complement the health physics principles learned in the lecture periods. Tours of local nuclear facilities show students the wide range of applications and uses of radiation sources, radioactive materials, and the associated radiation protection procedures. Lecture and laboratory topics include:

Radiation Physics	Shielding and Facility Design
Radiation Detection and Measurement Techniques	Health Physics Principles
Radiation Dosimetry	Radioactive Material Control Techniques
Radiation Biology	Environmental Monitoring
Waste Disposal	

Beginning with fundamental principles, each topic progresses to an advanced level. Instruction is reinforced with weekly examinations and problem sessions. A final examination is given at the end of the course. Individual attention is assured by limiting course enrollment to 24.

A typical schedule for this course is printed on the back of this brochure.

WHO SHOULD ATTEND?

Any person needing training in health physics and radiation protection should attend this course. Students should have some training in mathematics, including algebra, and have experience using a calculator with scientific functions.

RECENT COURSE PARTICIPANTS

Recent attendees include health physicists from nuclear power plants, emergency planning personnel, college and university campus radiation safety officers, industrial radiation protection officers, and military radiation protection personnel.

COURSE CREDIT

A certificate of completion will be awarded by Professional Training Programs to all participants. For physicians, this course will satisfy most of the basic science training hours required for license in medical uses of by-product material. For reactor health physicists, this course will provide 200 hours toward the licensing requirements for nuclear power plant health physics personnel. For more information on licensing requirements, contact your state's health department or the U.S. Nuclear Regulatory Commission.

COST

A tuition of $6,000 includes the full cost of training, books, instructional materials, and tours. Tuition does not include living expenses.

REGISTRATION

To ensure enrollment, a completed application form should be returned along with an enrollment fee of $500, which is applied to the $6,000 tuition fee. The enrollment fee is nonrefundable unless the course is cancelled by ORAU due to insufficient enrollment.

In lieu of sending an enrollment fee, your employer may submit a purchase order for the full fee with your application form. In the event of your cancellation, your employer will be responsible for payment of the enrollment fee. Substitutions will be permitted by written request to the registrar and must be received one month prior to the course starting date.

Applications may be submitted at any time until one month prior to the course starting date; however, early registration is recommended. Applicants will be sent additional registration, housing, and transportation information one month prior to the course starting date.

LIVING ACCOMMODATIONS

Motels and efficiency apartments are available in Oak Ridge at reasonable rates and are conveniently located within a short driving distance of the training facilities. Participants are responsible for their own housing arrangements.

ADDITIONAL INFORMATION OR ASSISTANCE

Additional information and assistance may be obtained by writing or telephoning between 8 a.m. and 4 p.m. eastern time:

Registrar, Professional Training Programs
Oak Ridge Associated Universities
P. O. Box 117
Oak Ridge, TN 37831-0117
Telephone: (615) 576-3576
FTS: 626-3576

APPLIED HEALTH PHYSICS
First Week

DATE	TIME	TOPIC
Monday	8:30 a.m.	Welcome, Registration, Orientation and Photo
	9:30 a.m.	Pre-Quiz
	10:30 a.m.	ATOMIC AND NUCLEAR STRUCTURE
	1:00 p.m.	MODES OF RADIOACTIVE DECAY ALPHA, BETA, AND ELECTRON CAPTURE
	2:00 p.m.	LABORATORY TECHNIQUES
	3:00 p.m.	Lab Lab Techniques and Sample Preparation
	4:00 p.m.	Math Review and Calculator Usage
Tuesday	8:00 a.m.	CHARGE PARTICLE INTERACTIONS
	9:30 a.m.	RATES OF RADIOACTIVE DECAY
	10:30 a.m.	GAS-FILLED RADIATION DETECTORS G-M COUNTERS
	1:00 p.m.	Lab G-M Counting
	4:30 p.m.	Reception
Wednesday	8:00 a.m.	Problem Session 1
	9:00 a.m.	GAS-FILLED RADIATION DETECTORS PROPORTIONAL COUNTERS
	10:00 a.m.	GAMMA-RAY EMISSION AND INTERNAL CONVERSION
	11:00 a.m.	COUNTING STATISTICS I
	1:00 p.m.	COUNTING STATISTICS II
	2:00 p.m.	Lab A) Proportional Counting B) Statistics
Thursday	8:00 a.m.	PHOTON INTERACTIONS I
	9:00 a.m.	PHOTON INTERACTIONS II
	10:00 a.m.	PHOTON INTERACTION COEFFICIENTS
	11:00 a.m.	QUANTITIES AND UNITS EXPOSURE
	1:00 p.m.	QUATITIES AND UNITS ABSORBED DOSE DOSE EQUIVALENT, AND NCRP #39
	2:00 p.m.	Lab A) Statistics B) Proportional Counting
Friday	8:00 a.m.	Problem Session 2
	9:00 a.m.	RADIATION BIOLOGY
	10:00 a.m.	NATURAL BACKGROUND RADIATION
	11:00 a.m.	POINT LINE, AND VOLUME SOURCES
	1:00 p.m.	Lab Assay of Samples Using GM Counters
	3:00 p.m.	Quiz I

APPLIED HEALTH PHYSICS
Second Week

DATE	TIME	TOPIC
Monday	8:00 a.m.	Quiz Review
	9:00 a.m.	SCINTILLATION DETECTORS
	10:00 a.m.	SURVEY INSTRUMENTS
	11:00 a.m.	GAMMA-RAY SPECTORSCOPY AND RADIONUCLIDE IDENTIFICATION
	1:00 p.m.	Lab A) GM Survey Instruments B) Gamma-Ray Spectroscopy I
	3:00 p.m.	Lab A) Gamma-Ray Spectroscopy I B) GM Survey Instruments
Tuesday	8:00 a.m.	RADIATION SHIELDING I
	9:00 a.m.	EXTERNAL DOSIMETRY AND PERSONNEL MONITORING
	10:00 a.m.	DETECTION LIMITS
	11:00 a.m.	GAMMA-RAY SPECTROSCOPY II
	1:00 p.m.	Lab A) Scintillation Survey Instruments B) Gamma-Ray Spectroscopy II
	3:00 p.m.	Lab A) Gamma-Ray Spectroscopy II B) Scintillation Survey Instruments
Wednesday	8:00 a.m.	Problem Session 3
	9:00 a.m.	RADIATION SHEILDING II
	10:30 a.m.	THERMOLUMINESCENT DOSIMETRY
	1:00 p.m.	Lab A) TLD Systems B) Film Dosimetry
	3:00 p.m.	Lab A) Film Dosimetry B) TLD Systems
Thursday	8:00 a.m.	10CFR20
	9:30 a.m.	ABSOLUTE COUNTING
	10:30 a.m.	SURVEY INSTRUMENT CALIBRATION
	1:00 p.m.	CONTAMINATION SURVEYS
	2:00 p.m.	Lab A) Absolute Counting B) Contaminations Survey
	3:30 p.m.	Lab A) Contamination Survey B) Absolute Counting
Friday	8:00 a.m.	Problem Session 4
	9:00 a.m.	TRANSIENT AND SECULAR EQUILIBRIUM
	10:00 a.m.	DELAYED EFFECTS OF RADIATION
	1:00 p.m.	Quiz II

APPLIED HEALTH PHYSICS
Third Week

DATE	TIME	TOPIC
Monday	8:00 a.m.	Quiz Review
	9:00 a.m.	FACILITY DESIGN
	10:00 a.m.	AIR SAMPLING: EQUIPMENT AND PROCEDURE
	1:00 p.m.	FUME HOOD DESIGN AND TESTING
	2:00 p.m.	Lab A) Ventilation System Testing B) Ventilation and Filtration
	3:30 p.m.	Lab A) Ventilation and Filtration B) Ventilation System Testing
Tuesday	8:00 a.m.	AIR SAMPLER CALIBRATION
	9:30 a.m.	RADON MONITORING
	11:00 a.m.	STACK SAMPLING
	1:00 p.m.	Lab A) Air Sampler Calibration B) Air Sampling
	2:30 p.m.	Lab A) Air Sampling B) Air Sampler Calibration
Wednesday	8:00 a.m.	Problem Session 5
	9:00 a.m.	INTERNAL DOSIMETRY I
	10:00 a.m.	BETA DOSE DETERMINATION
	11:30 a.m.	Lab Quality Control Follow-up
	1:00 p.m.	LIQUID SCINTILLATION COUNTING
	2:30 p.m.	Lab Liquid Scintillation Counting
Thursday	8:00 a.m.	INTERNAL DOSIMETRY II
	9:30 a.m.	ACUTE EFFECTS OF RADIATION
	10:30 a.m.	BIOASSAY
	1:00 p.m.	RADIATION PROTECTION GUIDES ICRP #26
	2:00 p.m.	Lab Survey Instrument Calibration
	4:00 p.m.	Lab Internal Dose Problem
	5:00 p.m.	Picnic
Friday	8:00 a.m.	BREMSSTRAHLUNG CHARACTERISTIC X-RAYS AND X-RAY TUBES
	9:00 a.m.	X-RAY SHIELDING
	10:30 a.m.	INDUSTRIAL USES OF RADIATION
	1:00 p.m.	GLOVEBOX SAFETY
	2:00 p.m.	Lab Computer Techniques
	3:30 p.m.	Quiz III

APPLIED HEALTH PHYSICS
Fourth Week

DATE	TIME	TOPIC
Monday	8:00 a.m.	Quiz Review
	9:00 a.m.	TRANSPORTATION REGULATIONS
	10:30 a.m.	RESPIRATORY PROTECTION
	1:00 p.m.	Tour ORNL Reactors/Resoratory Facilities
Tuesday	8:00 a.m.	DECONTAMINATION AND DECOMMISSIONING OF NUCLEAR FACILITIES
	9:30 a.m.	MPC, DAC, ETC
	11:00 a.m.	SEMICONDUCTOR DETECTORS I
	1:00 p.m.	SEMICONDUCTOR DETECTORS II
	2:00 p.m.	Lab High-Resolution Gamma-Ray Spectroscopy
	4:30 p.m.	Tour Nucleus
Wednesday	8:00 a.m.	Problem Session 6
	9:00 a.m.	MEDICAL USES OF RADIATION
	11:00 a.m.	SEALED SOURCE DESIGN TESTING AND LEAK TESTING
	1:00 p.m.	ATMOSPHERIC DISPERSION OF RADIONUCLIDE
	2:00 p.m.	Lab High-Resolution Gamma-Ray Spectrometry
Thursday	8:00 a.m.	RADIONUCLIDE PATHWAYS TO MAN
	9:30 a.m.	ENVIRONMENTAL MONITORING
	10:30 a.m.	ENVIRONMENTAL SAMPLE PREPARATION AND ASSAY
	1:00 p.m.	PROTECTIVE CLOTHING
	2:00 p.m.	Lab A) Protective Clothing B) Alpha-Particle Spectroscopy
	3:30 p.m.	Lab A) Alpha-Particle Spectroscopy B) Protective Clothing
Friday	8:00 a.m.	Problem Session 7
	9:00 a.m.	ACCELERATOR HEALTH PHYSICS
	10:30 a.m.	PREPARING FOR RADIATION EMERGENCIES
	11:30 a.m.	RADIATION ACCIDENTS REACTS TV TAPE
	1:00 p.m.	RADIATION ACCIDENTS
	2:00 p.m.	Tour REACTS
	3:00 p.m.	Quiz IV

APPLIED HEALTH PHYSICS
Fifth Week

DATE	TIME	TOPIC
Monday	8:00 a.m.	Quiz Review
	9:00 a.m.	NEUTRON SOURCES
	10:00 a.m.	NEUTRON INTERACTIONS
	11:00 a.m.	NEUTRON DETECTION
	1:00 p.m.	NEUTRON ACTIVATION
	2:00 p.m.	Lab NAA
Tuesday	8:00 a.m.	FISSION AND CRITICALITY
	9:00 a.m.	REACTORS I
	10:00 a.m.	Lab A) BF_3 Detectors B) Neutron Survey Instruments
	1:00 p.m.	NEUTRON PERSONNEL MONITORING
	2:00 p.m.	Tour DATEC
Wednesday	8:00 a.m.	CHERNOBYL
	9:00 a.m.	WASTE DISPOSAL
	10:00 a.m.	Lab A) Neutron Survey Instruments B) BF_3 Detectors
	1:00 p.m.	Lab Radiation Drill
Thursday	8:00 a.m.	Problem Session Review
	9:00 a.m.	REACTORS II
	10:00 a.m.	NEUTRON SHIELDING
	11:00 a.m.	SEG WASTE COMPACTOR
	1:00 p.m.	RADIOACTIVITY IN CONSUMER PRODUCTS
	2:30 p.m.	Tour SEG
Friday	8:30 a.m.	Quiz Final
	10:00 a.m.	HEALTH PHYSICS CHALLENGES
	11:00 a.m.	Course Critiques
	11:30 a.m.	Commencement

APPLIED HEALTH PHYSICS COURSE **APPLICATION FORM**

Yes, I would like to attend [ ] April 9–May 11, 1990
[ ] September 10–October 12, 1990

Name ____
Last First Middle

Employer/Sponsor ____

Department ____________________ My position ____________________

Business address ____

City ______________ State ______ Zip ________ Telephone (__) ________

Citizenship: [ ] USA [ ] Other, specify country ____________________

Highest level of education completed:

[ ] one [ ] two [ ] three [ ] four years college

[ ] BA/BS [ ] Master's [ ] Ph D. [ ] Other ____________________

Enclosed is my $500 enrollment fee, made payable to ORAU, paid by:

[ ] check number ____________________

[ ] purchase order number ____________________

The $5,500 balance is due on the first day of the course.

In lieu of the enrollment fee, I am enclosing the full course fee of $6,000 made payable to ORAU, paid by:

[ ] check number ____________________

[ ] purchase order number ____________________

____
Signature of applicant Date prepared

Mail this form and fee to

Registrar, Professional Training Programs
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, TN 37831-0117